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CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The annual meeting of the National Electric Light Association for 1900 showed no departure from the steady improvement of the lighting men's conventions year after year. Incidentally, this year's convention was notable for the large attendance of ladies and the enjoyable nature of their visit, due to the entertainment provided and the pleasantness of the weather. But it is the purpose to speak here of the deep interest displayed by the members in three subjects brought up by the papers; those of accounting, meter rates and arc lighting. The last was brought up by two papers, was freely discussed after both, and received by far the greatest attention of any subject brought up. A prominent fact in connection with this discussion is that the uncertainty and the difficulty of choosing between the different methods of operating arc lights, which has been so evident during the last two years, has largely passed away. For street arc lighting, at least in districts not covered by constant-potential mains, there was no one to dispute the advantage of operating alternating-current arc lamps on series circuits supplied by constant-potential alternators serving also to supply incandescent lights and motors.

Naturally, the first objection to such a plan was the reputed lower economy of the alternating arc than the direct-current arc as a light producer. As an answer to this, the work of the committee appointed by the Association to investigate this subject showed that the alternating arc, as a general thing, is nearly equal in economy to the direct-current arc, and that of constant-potential or multiple lamps the alternating enclosed arc gives off practically the same amount of light as the direct-current enclosed arc, when absorbing the same amount of power from the lines. In this comparison the direct-current lamp suffers, of course, because of the fact that about 30 per cent of the power taken by it from the lines is wasted in dead resistance, the waste of the alternating arc being considerably less as the necessary choking effect can be largely obtained inductively, and hence without waste. In comparing series alternating with series direct-current arcs, this greater waste of the direct-current system is not found, as no choking is necessary. Therefore, in the comparison of these two systems, the direct is superior to the alternating as a light producer, on the basis of comparison used by the committee, while the alternating arc can be supplied from large stations at least at sufficiently lower cost than the direct to offset the advantage of the light-producing element of the system.

Some of the attendants at the convention were willing to let the matter rest with this conclusion, but others were more enthusiastic for the alternating arc. These contended that the standard of merit assumed by the committee, viz., the mean spherical or mean hemispherical or mean 20-degree candle-power of the arc, as measured on a photometer, is not true practical standard of value, but is merely a theoretical basis. They argued that while they would not believe it until they had tried it, and while others would not believe it before trial—so firmly are we attached to theories with which we have been brought up—nevertheless a number of alternating arcs give better, that is, more generally satisfactory, illumination of a street than do an equal number of direct-current arcs of the same wattage. Whatever the reason may be, whether the law of inverse squares is not correct or the eye is deceived by different brilliancies, the photometer

gives a very poor idea of the relative illumination given by different varieties of lamps. It is well recognized that, while an opalescent inner globe cuts off about 30 or 40 per cent of the light entering it, the diffusion given by it will be better than that given by a clear globe, and at considerable distances from the arc the illumination may be better. It is probably true that the eye is better impressed with a uniform intensity of illumination throughout its range of vision that with a strongly concentrated light at one point and comparative darkness at others. In the latter case the eye adjusts itself to the strongest light and sees little or nothing in the comparative darkness. Probably the effect, so far as being able to pick out objects at a distance is concerned, would be better if the illumination at all points on a street lit by arc lamps less than 250 feet apart could be cut right down to that of the darkest portion of the street midway between two lamps. The eye would adjust itself to the comparative dimness, the pupil would dilate, there being no points of intense brilliancy to prevent it, and the vision would be improved. By this line of reasoning the fact that the opalescent globe appears to give as good or better illumination than the clear globe can be explained. By the same argument the advantage of the alternating arc can be explained. Throwing out a greater portion of its light in a horizontal direction, the direction to illuminate best the darkest points between lamps, it gives a more uniform diffusion than does the direct-current lamp. Hence its superiority.

This argument, if borne out by experience, settles most satisfactorily the perplexing problems of the station manager called upon to operate a large number of arc lights. In the attempt to avoid the shafting and belting required to drive series arc machines from large engines mechanically, he has used alternators and synchronous or induction motors, thus involving three sets of dynamo-electric machinery between his engine and his line. If the alternating arc is better than, or even as good, as the direct-current arc, he can dispense with his alternating motors and series arc machines, the two most expensive, most roomy, most troublesome and least efficient of his three types of dynamo-electric machines, and supply his arc lines direct from his alternating-current generators with the intervention only of constant-current regulating devices, of which there are now two satisfactory forms on the market.

THEORY.

In another column a correspondent registers a protest against the invidious distinction so frequently made between theory and practice and, somewhat singularly, a professor is referred to as being a particularly hardened sinner in this respect. We venture to say that the latter is connected with one of the schools, unfortunately yet numerous, in which training of intellect is subordinated to practical instruction with a view to giving a student a wage-earning capacity immediately upon his graduation. While in certain sections of the country public sentiment may require that a student upon graduation shall be qualified for practical work, we believe it is coming to be more and more recognized that the proper function of a technical school is the inculcation not of practice but of principles—that is, of theory in the popular acceptance of the word.

At the present day, and particularly in electrical engineering, those who harp on the difference between theory and practice can generally be set down as lacking in real knowledge of the former or, if instructed in theory, lacking in ability to apply it to practice. Ten years and even less ago the idea that there is an incompatibility between theory and practice was, it cannot be gainsaid, quite prevalent in the electrical field, and there was some reason for the prejudice then existing. In former days the branch of electricity was part of college courses in physics, and the instruction given by the professors of physics was absurdly out of phase with the developments of the early years of electric lighting. Later when graduates from electrical technical courses entered the field, the lack of practical knowledge on their part naturally led to ridiculous blunders, and the youthful assumption of superior knowledge still further prejudiced against them the pioneers who, generally through the possession of high natural abilities, had built up a great industry.

To-day the young men of those days, sobered by experience and ripened in judgment, dominate every branch of the electrical field. While much of the theory they learned has never been applied and perhaps a greater part is forgotten, the mental training which comes from the study of mathematics and pure science has proved a powerful factor in practical life. This training has led to success, not only when applied in a technical career, but in the executive and commercial branches of the electrical industry, and even in fields having no relation to that in which college instruction was received. We believe it can be stated as a fact that the graduates from those schools which have laid the most stress upon the teaching of principles, have been much more successful than those which have most prided themselves that a large percentage of their graduates have procured profitable positions immediately upon graduation.

CYLINDER LUBRICATION.

In one of the papers read at the Chicago Convention, the subject of cylinder lubrication was considered, and much stress laid upon the selection of a proper cylinder oil. The author of the paper states he has obtained the best results in cylinder lubrication from a "heavily compounded" high fire-test oil, and from the context it appears that the compounding consisted in the addition of animal or vegetable oil. In the case of surface condensation the use of such compounded oils cannot be too strongly condemned. Indeed, the chief engineer of a naval vessel who would permit any other than a pure mineral oil to enter an engine cylinder would be subject to court-martial. Even in the case of engine plants where the water is not returned to the boiler, it is not advisable to use animal or vegetable oil, as such use is likely to lead to corrosion of the metal surfaces with which the condensed exhaust comes into contact. Moreover, it is difficult to see the utility of compounding oils. The selection of an oil depends principally upon the temperature at which it is to be used, and pure mineral oils may be procured suitable for the several temperatures practically employed. Usually the condensation is sufficient in other than the high-pressure cylinder to obviate the use of oil, but at any rate the oil carried over from the high-pressure cylinder should be amply sufficient for the following ones. In point of fact, with well-constructed engines of the marine type, it is doubtful if any cylinder lubrication at all is needed. The lesson in the selection of cylinder lubricating oils was learned in marine service when surface condensation was introduced, during the first few years of which period the deterioration of marine boilers was startling. While the application of zinc and the use of mineral oil were simultaneously begun, the stoppage of deterioration was most probably entirely due to the change from organic to mineral cylinder oil.

PHOTOMETRIC VALUES OF ARC LAMPS.

A Committee on Arc-Light Photometry, appointed by the National Electric Light Association, has published a full report, an abstract of which appears in our columns this week. The report is interesting not only for the methods of measurement employed, but also for the results and conclusions to be reached therefrom. The arc light is so erratic and variable by comparison with the incandescent lamp, that it is very difficult to obtain concordant measurements of luminous intensity from single measurements in any given direction. For practical purposes outside of the photometry room—that is to say, in the street or shop where the lamp is installed—it is almost hopeless to obtain reliable readings without erecting what is practically a photometer chamber in proximity to the lamp. Consequently, for all

industrial work, it has become a recognized custom to estimate upon and specify for 450 watts supplied to direct-current, 10-ampere arc lamps of 2000 maximum candle-power intensity. The 450 watts is always easy to measure, while the candle-power is apt to be honored more in the breach than in the observance.

The method of measuring the luminous intensity of the arcs employed by the committee has evidently been to obstruct the direct light from the arc or arc-lamp globe, and to employ beams reflected from two opposite mirrors, one on each side of the lamp, the object being to obtain a more nearly uniform illumination at the photometer, so that if the arc should travel from one side of the crater to the other, one mirror would be more active than the other, but the total light thrown from both collectively would be nearly constant. By this means the results appear to show that the fluctuations of illumination on the photometer screen were cut down to one-third of those which would result from an unobstructed view of the arc lamp without mirrors. The next notable feature in the measurements consisted in the use of a slotted revolving sector, interposed between the observer and the photometer screen, so arranged that the view of the screen was cut off from the eye except when a slot was passing. By this means the visual effect of the illumination on the photometer screen was greatly reduced, just as though both the standard incandescent lamp and the arc lamp under measurement had both been transported to correspondingly increased distances from the screen. It is mentioned in the report that Ferry has found an error in the use of a sectored disk when applied to a single source of illumination, because the ratio of the light transmitted to light cut off does not appear to be the ratio of the open to the closed sectors when the opening is small. We think this can scarcely be a correct statement; the light transmitted through a revolving slotted disk must be in strict proportion to the width of the slots, but the visual effect of such intercepted flashes of light on the retina is, no doubt, liable to a certain amount of error from physiological causes, when the slots are narrow. By using the revolving sector in front of both sides of the photometer screen it is presumable that all such error was eliminated from the observations of the committee.

The object of diminishing the visual intensity of the illumination received at the photometer screen was for the purpose of suppressing the difference of color between the arc light and the incandescent light. This is a very interesting expedient for comparing lights of different colors, and promises to be useful in securing consistence in such comparisons, but it by no means follows that the color variation error is entirely eliminated thereby, or that the art of photometric comparison of differently colored flames is thereby rendered accurate. Strictly speaking, we think that there cannot be such a thing as accuracy of photometric comparison between two luminous sources of markedly different colors, as the instrument employed—i. e., the eye—is a physiological one, and its condition not only varies between different observers, but also at different times with the same observer. If, however, the personal variation can be reduced by dimming in equal ratio the two illuminations compared, the advantage of obtaining concordant results would for practical purposes be as valuable as though the absolute accuracy of the observations were increased to the same degree.

All the measurements appear to have been reduced as closely as possible to the same conditions of carbons and carboning and to mean spherical candle-power. It is needless to say that with an arc lamp in which the luminous intensity varies enormously in altitude, and with the addition of two enclosing globes of variable transparency or translucency, it would be perfectly hopeless to base a comparison upon anything but the spherical candle-power or upon what is in theory, the total flux of light emitted from the external globe. Owing to the deplorable absence of suitable units in photometry, the results are expressed in terms of a new and curious unit of light flux; namely, the flux through 4π steradians concentric to a standard Hefner-Alteneck lamp as point source. In view of the fact that the Hefner-Alteneck lamp is coming into very extended use in electric lighting photometry, such a unit deserves recognition. It might conveniently be called 4π Hefner-lumens.

The results show that the mean spherical candle-power of an enclosed arc lamp supplied from 110-volt circuits is practically the same for a given amount of power in the neighborhood of 450 watts, whether it be designed for and operated by alternating currents or direct currents. This is an important generalization, and is affected by the Joulean waste of energy in each type of lamp. In the case of seven alternating-current lamps the mean intake at terminals was 417 watts, of which 342 appeared in the arc, or 82 per cent. The corresponding mechanism-efficiencies of the direct-current lamps do not appear to be given in the published report, but would have presumably a not very different value. This generalization is quite reasonable and useful, and is contrary to popular belief. The same thing was formerly true in connection with incandescent lamps. It was long supposed that the candle-power of alternating-current incandescent lamps was appreciably different from the candle-power of the same lamps operated by direct currents, and it was not until very careful photometric measurements were made that the alleged discrepancy disappeared. In the same way, although the results given in the published report do not seem to have been directed to a comparison of electric power at the carbons, but to the more important practical condition of power at the lamp terminals, the result seems to be similar, and means that if a given amount of power in direct or alternating watts be developed in an arc lamp from a 110-volt circuit, the total output of light flux will be practically the same, assuming that the lamps are of the same type, have similar enclosing globes, and are trimmed with the same quality of carbons.

The next important conclusion to be derived from the report is that the economy of enclosed arc lamps of either the direct or alternating-current type as expressed in watts per mean spherical candle-power is nearly the same as for incandescent lamps. Thus with an external globe, the results with the direct-current arcs represent about 3.45 watts per spherical candle, and for the alternating-current arcs 3.63 watts per spherical candle, or a mean of 3.54. Good central-station practice with incandescent lamps gives about 3.25 watts per mean horizontal candle, which is approximately the equivalent of 4 watts per mean spherical candle-power, so that the economy of a doubly enclosed arc lamp with an opalescent globe taking about 5 amperes is only about 13 per cent more than that of ordinary good incandescent lamps; while if the comparison were made with the best incandescent lamps, the two economies would be about equal.

The well known reduction in luminous output and in efficiency due to the use of an opalescent external globe, as distinguished from a clear globe, is well brought out in these results, amounting to something like 15 per cent. We believe, however, this deficit is more than made up in practice by the superior attractiveness of an external opalescent globe in conveniently diffusing illumination and reducing shadows. If arc lamps were employed with every consideration subordinated to light production, the naked vigor of the unenclosed lamp would be used, with an efficiency of more than one candle per watt. It is not only unpleasing but actually dangerous to gaze upon the naked arc lamp. On the other hand, however, it is in no way distressing to the eye to dwell upon an opalescent-covered enclosed arc lamp, and the aesthetic effect of such a lamp more than compensates for the incidental loss of light and power.

International Electrical Congress.

The following provisional programme for the International Electrical Congress has been adopted. The first session will be held Aug. 18, beginning at 10 a. m., and the Congress will continue to hold sessions until Aug. 25. During the Congress visits will be made to the more important electrical installations of Paris, the several parties to consist exclusively of members of the Congress.

SECTION I.—SCIENTIFIC METHODS AND MEASURING APPARATUS.

1. Units and Measures.—Recapitulation and co-ordination of the work of previous congress.

2. Methods of Measurement.—Methods for testing insulators, conductors and magnetic materials, and the specifications of qualities, Measurement of magnetic fields. Measurement of the power of single and polyphase alternating currents. Practical methods of resolving a periodic curve into its simple harmonics.

3. Measuring Apparatus.—Recent improvements in wattmeters, counters, phasemeters, hysteresis meters, oscillographs and rheographs.

4. Photometry.—Secondary standards. Comparison of photometric standards. Methods and apparatus for measurement.

SECTION II.—PRODUCTION OF ELECTRICAL ENERGY. TRANSMISSION AND DISTRIBUTION. ELECTRIC TRACTION. ELECTRIC LIGHTING.

1. Production of Electrical Energy and its Transformation.—Improvements in direct-current generators with respect to commutation. Standardization of methods of testing and definitions relative to machines—the definition in particular of maximum current, normal power, elevation of temperature and drop. Comparison of inductor and other types of alternators. Standardization of frequencies and the discussion of the best frequencies to adopt, taking into consideration price and efficient operation of machines. Compounding of alternators. Asynchronous generators. Influence on alternators in parallel of motors in circuit. Rotary converters, transformers and rectifying apparatus. The cost of the production of electrical energy in central stations. Choice of generating units with respect to size. Meters and rates of charge.

2. Transmission and Distribution.—High-tension lines. Rules with respect to the erection of high-tension lines along public highways, and measures of security. Grounding of circuits in the several systems of distribution. Lightning and lightning protectors. Automatic grounding of circuits when subjected to abnormal voltage. Comparison of synchronous and asynchronous motors. Applications of condensers.

3. Electric Traction.—Improvements in electric railway motors. Comparison between direct-current, three-phase and rotary-converter sub-station systems. Comparison between multiple unit and ordinary train system. Air resistance to moving cars. Maximum voltage allowable for urban and interurban systems, working and distributing circuits. Road bed. Electrolytic action.

4. Electric Lighting.—Luminous efficiency of the arc, and the comparison between direct-current and alternating-current arcs, open and enclosed. Series arc lighting. New types of incandescent lamps. Lighting of carriages and trains.

SECTION III.—ELECTRO-CHEMISTRY.

1 Theoretical Research.—Conductivity of rarefied gases. Velocity of ions. Chemical actions of the arc and of brush discharges. Organic decomposition by electrolysis.

2. Apparatus.—Recent improvements in primary batteries. Standard cells. Dry cells. Cells of high discharge rates. Storage batteries other than those of lead. Choice of storage batteries for traction, sub-stations and regulation. The electric furnace and its industrial applications.

3. Analysis.—Separation and dosage of metals. Industrial methods of analysis as employed in electrolytic plants.

4. Metallic Deposition.—Deposits of chrome, aluminum and zinc. Statistics from different countries giving the quantity of silver, copper and nickel deposited annually.

5. Metallurgy.—Electrolytic treatment of copper, zinc, lead and nickel minerals. Treatment of mattes. The direct production of articles by deposition in the electrolytic bath. Industrial refining of copper. Comparison between the cost of products obtained by electrolytic and metallurgic processes. Statistics as to the quantity of electrolytic copper and nickel employed in various countries.

6. Electrolytic Industries.—Electrolytic manufacture of chlorine, soda, chlorate of potash, calcic carbide and aluminum.

7. Miscellaneous Appliances.—Direct means of obtaining ozone. Appliances of ozone. Production of hydrogen and oxygen. Preparation of glucinum and its alloys. Preparation of calcic phosphate. Treatment of sugar solutions. Dyeing and bleaching.

SECTION IV.—TELEGRAPHY AND TELEPHONY. MISCELLANEOUS APPLIANCES.

1. Generation of Current.—Batteries. Magnetic calling apparatus. Employment of dynamos and storage batteries.

2. The Line.—Aerial lines of iron, steel, copper, bronze, aluminum and bi-metallic wire. Glass and porcelain insulators. Wooden poles and their preservation. Iron poles and towers, and their construction. Underground cables with insulation of rubber, paper, etc. Armored and lead encased cables. Manufacture of underground cables. Submarine cables, their insulation, manufacture, laying, repairing, etc. Submarine cables in telephony.

3. Apparatus.—Telegraphic apparatus, including multiplex, rapid sending, etc. Telephonic apparatus, including transmitters, receivers and repeaters. Bridging systems, telephone exchanges, etc.

4. Circuits.—Aerial, underground and mixed telephone circuits Grounded and metallic circuits. Non-inductive lines. Long-distance telephony. Simultaneous telephony and telegraphy.

5. Propagation of Telegraphic and Telephonic Currents.—Lines of small and large capacity. Velocity of transmission. Quantity of current.

6. Maintenance of Telephonic and Telegraphic Lines in Operation.—Disturbing actions, leakage, induction, etc. Lightning arresters.

7. Wireless Telegraphy.—Transmitters, receivers, coherers, aerial conductors and syntonization. Communication with and between vessels. Optical telegraphy.

8. Horologie.—Automatic rewinding. Periodic resetting. Time service. Application of the electric system to the present types of clocks.

9. Miscellaneous Appliances.—Signals and various calling systems.

SECTION V.—ELECTRO-PHYSIOLOGY.

1. Production of Electricity in the Human Organism.—So-called currents of repose in the different tissues, nerves, muscles, glands, etc. Currents in the same tissues. Currents and special organs in the electric fishes, and methods and instruments for the study of such currents.

2. Action of Electricity on the Human Organism.—Influence of the form of wave and characteristic effects. Electrification by the static machine, primary cell, induced currents, sinusoidal and undulatory currents and high frequency currents. Processes—Direct, by condensation, auto-conduction, brush discharges, etc.

5. Measuring instruments and miscellaneous physiological effects.

6. Danger from the different forms of electrical energy. Death by electricity and methods of resuscitation.

International Association of Municipal Engineers.

The executive committee of the International Association of Municipal Electricians held a meeting at the Clarendon Hotel, Brooklyn, N. Y., May 17, at 10 a. m. The meeting was presided over by Capt. William Brophy, president of the association. It was decided that four topics should be selected for discussion at the next meeting at Pittsburg, Pa., Sept. 25, 26 and 27, as follows: "Benefits to be Derived from our Association," by Capt. William Brophy, of Boston; "Contact Points," by Frank C. Mason, superintendent of Brooklyn Police Telegraph; "Trials and Troubles of Instituting and Enforcing Municipal Inspection and Control," by M. G. Canfield, of Grand Rapids, Mich.; "Automatic Fire Alarm Systems," by Charles Burger, of Boston.

It was also decided that there shall be two sessions daily, the morning session to begin at 9:30 and terminate at 1 p. m., and the afternoon session from 2:30 to 5:30 o'clock. Immediately upon roll call, which shall be the first order of business upon convening, all members not answering the roll call shall be recorded as being absent, unless reasonable excuse be given by such members to the presiding officer. The printing and distribution of reports of the Pittsburg Convention will be in charge of Morris W. Mead.

ENGINEERING SOCIETY LIBRARY UNIVERSITY OF MICHIGAN

The First Cuban Electric Railway.

THE first electric cars in the Island of Cuba commenced operations March 7, when the line from Regla to Guanabacoa was opened. It is a curious fact that this railway, which was previously operated by steam, was one of the very earliest roads in the Western Hemisphere, and the first in Cuba. Originally cars were run upon wooden rails, for which light iron rails were substituted about the year 1848. The track is about six miles in length, the terminus at Regla being on the opposite side of Havana Harbor, the ferry to the city of Havana being operated by the Cuban Electric Company. From Regla the line, which is single track with turnouts, passes through a very beautiful country, the scenery being tropical in nature, presenting a view of a series of vineyards and gardens, flanked by rows of palms. The country is gently undulated, with a gradual rise to Guanabacoa, which stands upon an elevation. The steepest grade is 4½ per cent upon a curve for a length of 500 yards. Guanabacoa is a summer resort containing a large number of handsome dwellings, which are the residences of many of the well-to-do citizens of Havana; it is also a popular place for excursions, and on this account provides a regular and remunerative traffic. The line having been previously a steam railroad, is of standard gauge and substantial construction.

The trolley wires are suspended from cross wires stretched between iron poles. Double trolley wires are used, positive and negative, as the military governor objected to the usual American system of a single trolley wire, necessitating the return circuit being completed through the rails. For the same reason there are two feeder wires, positive and negative. Fig. 2 gives a view of one of the cars, and shows the construction of the trolley and feeder systems. The power house is at Regla, alongside the ferry, which is two or three miles from Morro Castle, and commands a lovely view of the picturesque entrance to the harbor. The building is of brick with steel frames imported from the United States.

The electrical equipment was carried out entirely by the Westinghouse Company, and was erected under the superintendence of its engineers. The power house contains two 120-kw direct-current, engine-type, multipolar generators, direct-connected to two 220-hp steam engines, running at 200 r. p. m. The generators supply current at 550 volts. The power house has space for another unit, which will be added when the necessities of the line call for further power. The switchboard follows the usual Westinghouse practice, having two generator panels, one load and one feeder panel equipped with the usual apparatus for metering and controlling the current. Fig. 1 shows a view of the interior of the engine and dynamo room.

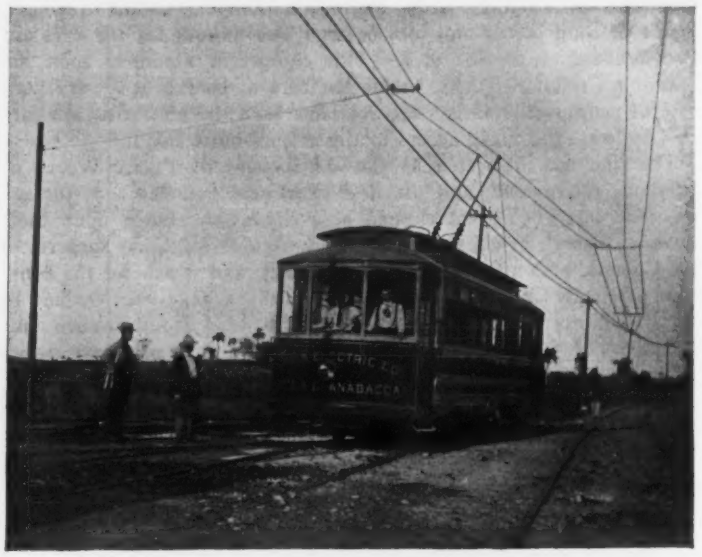


FIG. 2.—ONE OF THE CARS AT GUANABACOA.

The bodies of the cars are a slight modification of one of the standard American types that have been successfully used between Buffalo and Niagara Falls, being built by the J. G. Brill Company. The body is 28 ft. long with two 4-ft. platforms, making the length over the vestibule 36 ft.; the width at the walls is 7 ft. 5 ins., and at the belt rails 8 ft. The inside finish is ash and cherry with three-ply brick veneer finish. The seating capacity is 40, ten double cane

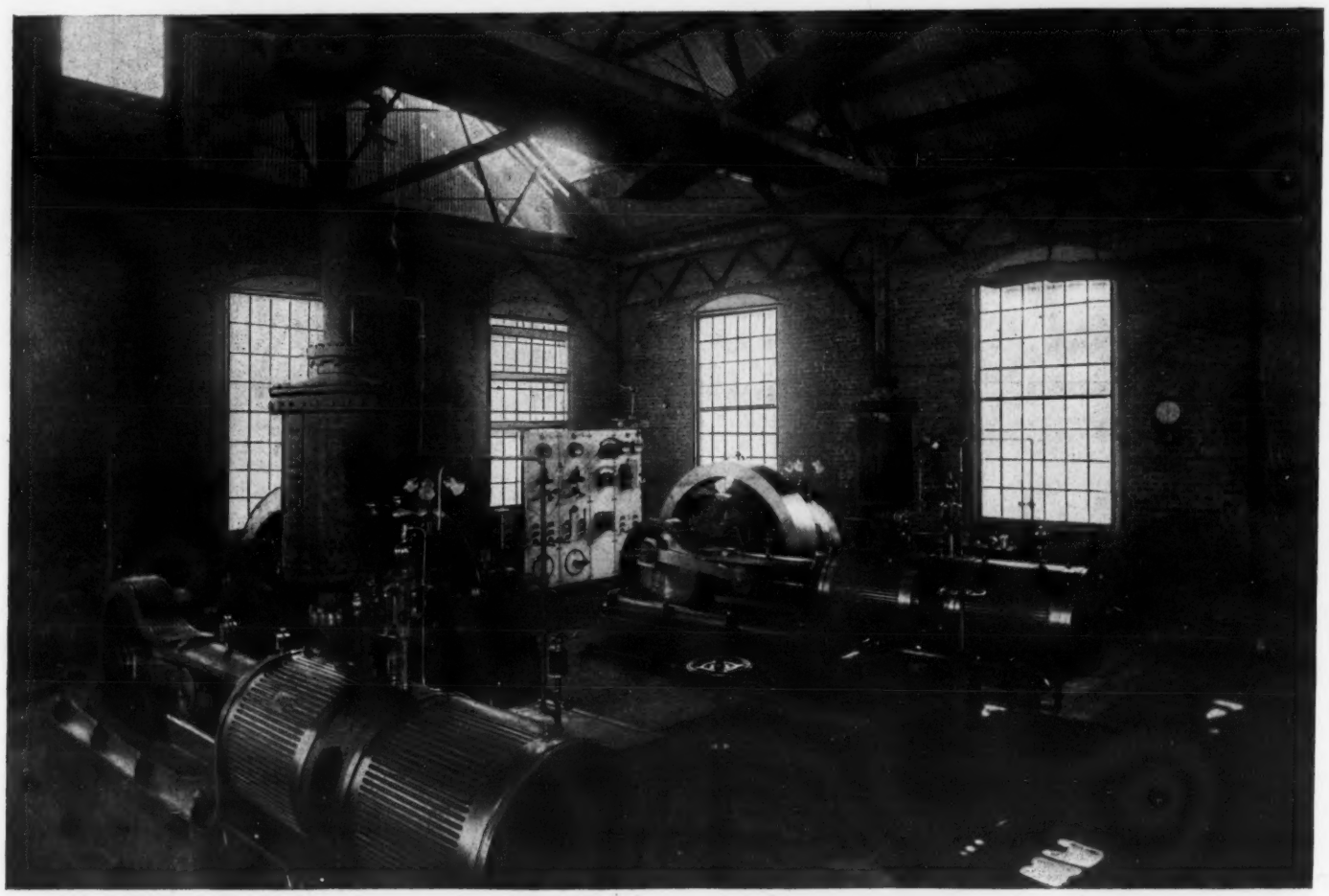


FIG. 1.—INTERIOR OF POWER STATION, CUBAN ELECTRIC COMPANY.

seats being placed on either side of a central aisle. The car is mounted on Eureka maximum traction trucks with 33-in. wheels, having 2¼-in. treads and ⅞-in. flanges. They are furnished with folding gates, angle-iron bumpers, radial drawbars, a pair of sand boxes, and tool boxes. The motors for the cars are two Westinghouse No. 38-B. This equipment mounted upon the maximum traction trucks, enable the cars to be run at a very high rate of speed with safety. At the same time the platforms are carried so low as to make access to the motors quite easy.

The line was inspected by the Department of Public Works at Havana, and passed, and the first cars were run Mach 7, the inspecting party being entertained at a champagne lunch upon their return. The electrical operation is a source of continual surprise to the Cubans, who make very quaint remarks, and watch for the emission of steam from the trolley poles. Cubans have been trained to serve as motormen and conductors, and are very proud of their uniforms. The fare from Regla to Guanabacoa is 5 centavos, somewhat less than 5 cents.

At the Paris Exposition.

CHAMP DE MARS POWER STATIONS.

ONE by one the engines of the Champ de Mars power stations in the Electricity Building are being put in operation. The night fête of April 29 was intended to utilize current from nearly all the large machines especially those which have lacked only finishing touches since the official day of opening; but the only machines that actually provided illumination were the direct-connected set by Garnier & Faure-Beaulieu and Postel-Vinay, and the faithful gas engines of Charon with belt-driven dynamos by the Nancy General Electric Society. These two dynamos, of 45 kilowatts each, have been doing duty since last December, serving for illumination and for operating the large electric crane. On the occasion mentioned, the machines were run in series, feeding a 220 + 220-volt three-wire circuit, and the Postel-Vinay dynamo was connected across the outer mains, furnishing about 200 amperes at 440 volts. This current was used for local illumination in the Electricity Building and adjacent parts.

In the Belgian section of the foreign power house the engine and generator by Carels Bros., of Ghent, and Kolben & Co., of Prague, is ready to run. The engine, at the station pressure of about 140 lbs. per square inch, will give 1000 horse-power at 94 r. p. m., and at higher speed a maximum output of 1250 horse-power. There are two cylinders, working tandem, the diameters being 26 ins. and 41¼ ins. for high and low pressure, respectively, and the stroke 45¼ ins. The air pump is worked by means of a connecting rod on an extension of the crank pin, and the condenser is situated in a vault below the engine room floor. The engine has a guaranteed efficiency of 94 per cent, and the dynamo 96 per cent, or a combined efficiency of 90 per cent. Kolben & Co., who built the dynamo, have their own steel foundry at Prague, which permits of extensive use of steel castings and accurate results. The present machine is a three-phase, star-connected, 750-kw alternator, with revolving field. There are eighty poles, of cast steel, with laminated pole tips "cast in" the mold when pouring the steel. The diameter of the field at the air-gap is 18 ft. 9 ins., and the weight of the revolving wheel is 25 tons. The design makes use of double spokes, combining lightness with strength, and the resulting weight is a mean between those used by the two other Belgian firms exhibiting, one being 20 tons and the other 36 tons, for

FIG. 1.—BOLLINCKX 1100-HP CROSS-COMPOUND ENGINE, BELGIAN SECTION, FOREIGN POWER HOUSE.

machines of about the same horse-power. Since the engine has tandem cylinders, hand gearing is provided for moving the flywheel from the dead centre and for slow rotation for inspection, a ratchet connection allowing the wheel to move forward if the engine should be started while the gears are in. The armature frame is movable sideways for purposes of inspection or repairs, being drawn over by screws turned by levers. The exciter is mounted on the extension of the shaft beyond the bearing, and is a six-pole, 95-volt dynamo, giving 120 amperes for the field, taken off by carbon brushes.

For the present there is more power available than is required for lighting, owing to the general backwardness of the architectural department, and the possible output from this machine cannot be utilized in full. It is intended to supply current from here for lighting "Old Paris," and five transformers of 50 kilowatt capacity are installed, transforming from 3000 volts to 120 volts. In the Horticultural Palace are to be two similar transformers. For lighting the switchboard and the vaults beneath the engine room floor a 1½-kw transformer is used.

In the French power house there are only two triple-expansion engines, one by Dujardin & Co., of 1500 horse-power, horizontal type, not yet completed; and one by Dalaunay-Belleville, coupled to a compound alternator by Bréguet. This engine is of the vertical enclosed type, furnishing 1250 horse-power at 250 r. p. m. The high-pressure cylinder is 19⅝ ins. in diameter, the intermediate 24¾ ins., and the two low-pressure 33½ ins. each. The exhaust passes into a surface condenser, which is not the usual practice among the other exhibitors, who use jet condensers. A small motor drives a centrifugal circulating pump directly, and an air pump through gearing. The exciter, between the condenser and the engine, is driven by a Laval steam turbine, which machine is to be further represented in the French station in connection with two electric lighting units, to be described later. At the present time the above-mentioned vertical engine forms the centre of a group of three generating sets which are in readiness to run, one of these being the Garnier & Faure-Beaulieu engine with Postel-Vinay generator, and the other a single-cylinder 1000-hp horizontal engine by Weyher & Richemond, driving a 250-volt Creil dynamo. In order to provide for smooth running when so much power is concentrated in one cylinder, an extra heavy flywheel (weighing 30 tons) is keyed to the shaft. The governor, mounted on a disk close to the flywheel, is visible in the cut. Regulation is obtained by variation of centrifugal force, and not by inertia. The diameter of the cylinder of this engine is 35 7-16 ins., and the stroke 1 metre, or 39.37 ins., which, at 120 r. p. m., gives a piston speed of 787 feet per minute.

The electrical distribution of power from the generating sets is effected by means of cables laid in trenches dug in the earth floor of the power houses. It has not appeared as though much care has been bestowed on the installation in every case, as the workmen tore the insulating covering through walking over it in heavy nailed boots, and cable is still exposed in the same manner at various places. The

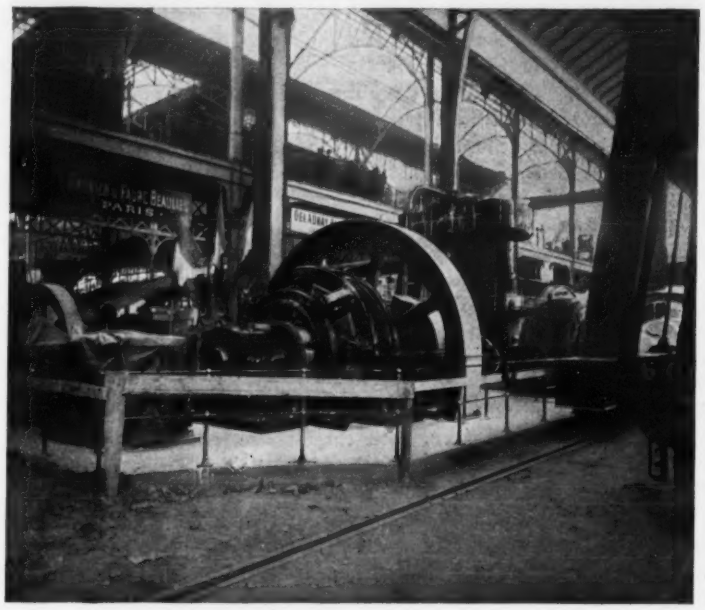


FIG. 2.—DIRECT-CONNECTED ENGINE AND DYNAMO, E. GARNIER AND FAURE BEAULIEU. FRENCH POWER HOUSE.

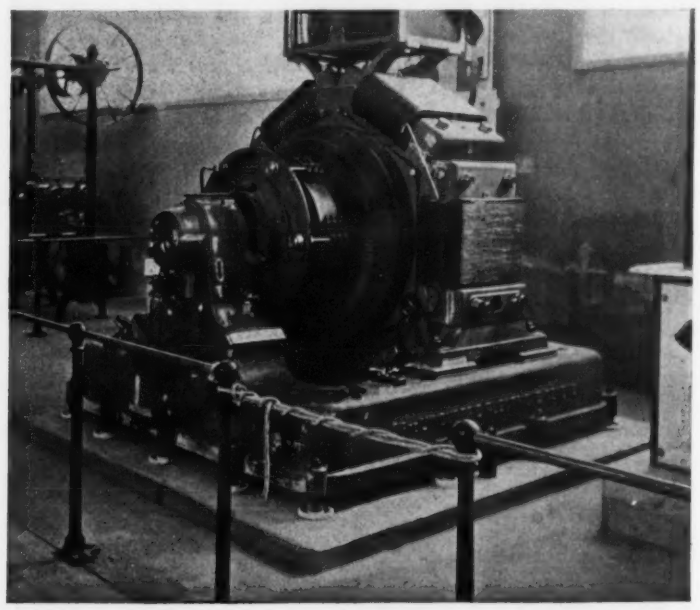


FIG. 4.—THURY 2500-VOLT, 400-HP GENERATOR, COMPAGNIE DE L'INDUSTRIE ELECTRIQUE. SWISS SECTION.

FIG. 3.—2200-VOLT GENERATOR, COMPAGNIE INTERNATIONALE D'ELECCITÉ (PIEPER). VAN DEN KERCHOVE ENGINE. BELGIAN SECTION.

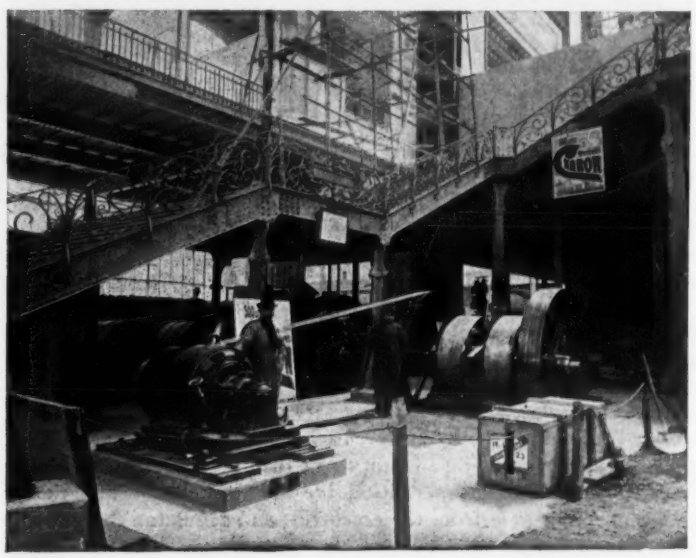


FIG. 5.—CHARON MOTOR (GENERAL SOCIETY OF INDUSTRIAL ECONOMY). FRENCH POWER HOUSE.

location of some of the cables seems to be in doubt, to judge from a report that one of the German machines, in a test run, was furnishing current at 2000 volts, while what was supposed to be the other end of the cable remained dead.

The opening fête of April 29 for Exposition soirées was not the occasion for brilliant illumination such as had been anticipated, as the engines were not all connected to the steam mains, and the distribution systems were not in order. Illumination of part of the grounds was obtained from the city lighting mains, and the gardens of the Trocadero were bright with incandescent gas burners; but the Exposition buildings were closed, and the crowd of visitors sought amusement among the attractions offered by side-shows in the "Rue de Paris," which was gaily decorated with incandescent lamps among the branches of the trees.

Belgium is very well represented among the foreign builders of engines and dynamos at the Exposition, and shows three groups of direct-connected generating sets. All these are of about the same output—1000 horse-power—and the engines are of the horizontal type; but some details of design are different in each case. Carels Bros., of Ghent, and Van den Kerchove, also of Ghent, make use of tandem compound cylinders, and the third maker, Bollinckx, employs the cross-compound construction, which permits of a much lighter flywheel than the single crank engines require for steady running. Each of the three manufacturers has selected a different style of valve for admission of steam to the cylinders. Carels Bros. use a vertically moving pop valve actuated by a rocking lever, the release being, of course, determined by the governor, for variation of cut-off; Bollinckx uses a form of Corliss valve, and Van den Kerchove has adopted vertically-moving balanced piston valves placed close to the cylinder ends on the vertical centre line. The upper end of the valve spindle enters a recess in which is a steel spring, operating to give instantaneous cut-off; and immediately beneath is a cylinder in which a piston on the valve spindle travels, taking up the shock of the closing of the valve by means of an air cushion, the compression being regulated by adjusting a screw by hand. The valves are designed to reduce the cylinder clearance to the lowest practicable amount, which in this case is not more than 2½ per cent. The use of balanced valves has permitted the employment of remarkably light connecting-rods from the eccentrics and regulator shaft to the valve levers.

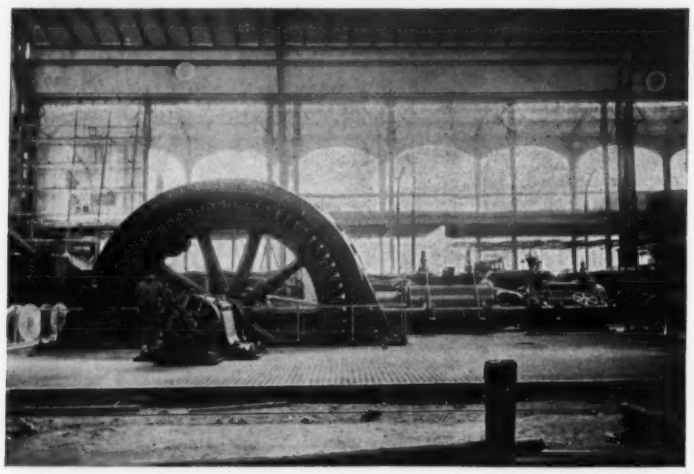


FIG. 6.—KOLBEN GENERATOR DIRECT-CONNECTED TO CARELS BROS.' ENGINE.

Steam-jacketed cylinders are in general use, Van den Kerchove having a double envelope on the high pressure cylinder; the steam enters the outer jacket and passes directly to the valves, and the inner jacket communicates with the end chambers by holes through which steam flows. The jacket for the low-pressure cylinder forms actually the receiver. The diameters of the cylinders are 24 13-16 ins. and 43 ins. for high and low pressure respectively, with a stroke of 47¼ ins. A small oil pump, worked by a crank on the end of the eccentric shaft, supplies oil to the bearings.

The general design of the alternator (built by the Compagnie Internationale d'Electricité) appears heavy; but a single-crank engine runs more smoothly when there is considerable weight in the flywheel rim, and for electric traction this is desirable. Two engines of this type, 500 horse-power, are to be used for the Paris-Arpajon line, coupled to Schuckert dynamos. The flywheel of the engine exhibited has a weight of 40 tons; round its periphery are 72 field magnets, with square pole tips. The armature frame is cast in four parts, two being bolted together to form the upper half and two for the lower half, while the laminated armature core is clamped between the opposing inner faces. The armature supports consist of ring-shaped pedestals surrounding the shaft and bolted to the central foundation, and the hub of the armature frame rests upon a turned cylindrical surface on the inner side of each support. This construction allows the rotation of the armature for purposes of inspection or for repair of coils, a small motor being used for turning the frame, by means of worm and spur gearing. The same machine is used for turning either the flywheel or the armature, motion being imparted through spur gears in the first case, and through a chain connection in the second case. To prevent any movement of the armature frame by reaction against the revolving field, the former is normally held in position by bolts passing through lugs into anchors in the foundation.

The armature pedestal on the outer side serves the double purpose of support for the stationary part of the alternator, and field frame for the exciter, which furnishes a maximum current of 180 amperes at 120 volts, at 83½ r. p. m. The number of poles in the field of the alternator being 72, the periodicity become 50, which is the frequency of nearly all the alternators in the two stations. The e. m. f. of this machine is 2200 volts, three-phase.

Van den Kerchove exhibits two Willans central-valve engines built by them, and coupled to direct-current machines by the Compagnie Internationale d'Electricité. One of these engines furnishes an output of 180 horse-power at 380 r. p. m., and the other is a 90-hp engine, running at 485 r. p. m. The smaller size is used principally for export to tropical countries. The maker of the above-described alternator shows also a 2200-volt three-phase motor dynamo of 100 kilowatts, the motor to be driven from the large alternator, and furnishing current, by means of the generator, to the circuits normally supplied by the Willans machines, should these be shut down. A 40-kw 3-phase alternator is also exhibited, with a small exciter on the main shaft, running at 600 r. p. m. and furnishing an e. m. f. of 530 volts.

Some very interesting direct-current generators are exhibited by the Compagnie de l' Industrie Electrique of Geneva. These are the well-known Thury machines, and the one in the accompanying cut gives an output of 400 horse-power at 2500 volts. Extra precautions against leakage of current are taken by placing the whole machine on porcelain insulators. The design of the field frame is the usual compact style adopted in these machines; to allow of removal of the armature, the pedestals are separate, but the circular arc forming the base is unusual for so large a machine. Above the field is the resistance box and field regulator, automatically varying the field resistance with change in speed and moving the brushes round by means of a wire cable round the brush-holder disc. An important power transmission plant from St. Maurice to Lausanne will use these machines.

A Thury revolving field alternator is direct connected to an Escher-Wyss triple-expansion engine, and gives a two-phase current of 47 amperes at 5000 volts. This machine is exhibited among the other, and larger, engines of the Escher-Wyss Company in the Swiss section of the foreign power house.

NOTES.

THE WATER PALACE slowly approaches completion, but it is stated by authorities that its electrical splendors will not be seen for two weeks to come. Meantime the eye feasts on its architectural and artistic beauties, while in the dark caves at its rear the plumbers are busy hunting for the leaky pipes that threaten to turn some of the adjacent American exhibits into plaster stalactites and stalagmites.

NATIONAL PHONOGRAPH COMPANY has prepared a fine exhibit of Edison phonographs, motors, etc., in Electricity Building, and will open up its space to the public as soon as cars get off the track in front and walk boarding is laid. In the meantime, Messrs. Stevens and Kayser are distributing a very handy guide to Paris and the Exposition, pocket size, illustrated, by Barrett Eastman and F. Mayer. The visitor who follows its advice will save much time and many a franc.

THE PALACE OF OPTICS went into operation last week on the Champ de Mars, and for a "side show" it is one of the most interesting things in the way of popular science that can be imagined. It not only shows the moon at three feet, but has a fine general col-

lection of optical apparatus and phenomena, while electricity is shown in all its practical and novel features. The number of incandescent lamps for lighting alone is put at 14,000, and there are numerous arcs for lighting, projection, etc. In the room to illustrate "cold light," there are over 800 vacuum tubes in operation; while in another room the use of the Roentgen ray is illustrated by a very lively young lady behind a full length vertical fluorescent screen. The efforts of the male part of the audience to peep into the box back of the screen must be seen to be appreciated. There is also an excellent display of high-tension, high-frequency effects.

OFFICIAL CATALOGUES. One of the most welcome premonitory symptoms of the week ending May 19 has been the setting up of some of the stands from which official catalogues will be sold. It is now over a month since the Exposition opened, but the only sections of the catalogue available are those relating to the fine arts, for which an electrical engineer has use sometimes, but not at this juncture. The absence of any lists of the electrical and mechanical exhibits is really a serious hardship to persons attending the show for purposes of business, and a great inconvenience to visitors. One is incessantly pestered with questions as to where this or that exhibit can be found, and when, as is often the case, the answer is: "At Vincennes," the expression of annoyance is very emphatic. Some of the exhibitors who paid large sums for advertising are talking of drawback claims for the period during which no catalogues of their goods have been on sale.

ATTENDANCE. The small attendance of visitors at Vincennes is a disappointment to those who have spent large sums of money on their exhibits in that park, but it is hoped that as the summer advances and the Thomson-Houston trolley from the boats up to the grounds gets in full operation, the numbers there will show a marked increase. On Sunday, May 6, there were about 210,000 at the main exposition and less than 5000 at Vincennes. During the week there was quite a row over the effort to push work there, many of the artisans being accused of loafing. M. Hubert, one of the chiefs of construction, in his endeavor to push things, dismissed a number of men for idleness; whereupon they turned to and gave him such pounding he had to be taken home in an ambulance quite badly injured. On Sunday, May 13, the attendance at the show ran up well above 300,000, and even Vincennes got over 10,000. The grounds everywhere were crowded, and in some places there was a crush, the areas for circulation being limited. In the evening, there was a big crowd around the Chateau d'Eau, assisting at an impromptu trial of the lighting effects in the shallow lower basin, with holophote glass boxes under the sheet of water. The effects obtained with the small portion of space and apparatus in use were very effective and pretty. The growth of the crowds with the approach of summer has led the authorities to connect the entrance gates up telephonically with a central point from which word can be sent to admit no more people, as soon as the crush becomes serious. The exact number of admissions that would represent danger is now being studied, and the gatekeepers are being instructed in the use of the precautionary telephone system.

MR. W. J. JOHNSTON, the former publisher of the *Electrical World*, is in Paris for a week, ending up his trip around the world, and, as he says, he could not desire a more complete review of his travels than is presented by the foreign sections of the show. He is very much pleased at the prominence of American exhibits, and considers the Vincennes display remarkably fine; but, like most mechanical people here, he is rather disappointed at not finding one of the typical engine and dynamo units of four or five thousand horse-power now becoming so common in the United States, but very scarce in Europe. Mr. Johnston spends a short time in England before returning home.

GERMAN SHIPPING EXHIBIT. The pavilion erected by the North German Lloyd and other German shipping and shipbuilding companies thrown open to the public during the past week, is a beautiful and highly attractive feature, reflecting the utmost credit upon the enterprise and good taste of those who contributed toward its creation. It owes some of its best exhibits to the use of electricity, including a huge globe revolved by electric motor, the globe as it spins around showing the routes of the German ocean steamship companies. There is also a fine model of the North German Lloyd office at Bremen, surmounted by a high tower equipped with a Marconi wireless telegraph system. The object of the service in actual practice is to enable the managers of the company to get into communication with their steamers the moment they come within etheric hailing distance or until they get beyond that point.

SIDEWALK AND THIRD RAIL. The two systems of transportation at the show are both much appreciated and are a decided success. In fact, it is impossible to imagine the show without them. From figures just obtained, it appears that in the period from April 15 to May 13, inclusive, they carried 799,479 paying passengers, at 10 cents for the sidewalk and 5 cents for the third rail, the large majority paying the higher fare. During the period named, one day was lost—April 21—owing to an accident having occurred on the transmission cable. The greatest number of passengers carried in one day was 75,000, on May 13, when that number was safely handled in ten hours. On Easter Monday, 61,000 passengers were "hauled." Such figures betoken larger returns even, for the crowds are growing and the night fêtes have yet to begin, as warmer weather comes on.

CHATEAU D'EAU FIRE. Great alarm was caused throughout the Exposition and Paris on Tuesday afternoon, May 15, by the report that the Chateau d'Eau and Electricity Building were on fire, support being given to the rumor by the headlong rush of firemen to the scene. Dense volumes of smoke rolled up from the cellars of the Water Palace, where the apparatus for operating the submerged electric lights was being placed, and it was not without great effort and damage that the fire was suppressed, its marks being left all over the lower part of the beautiful white stone work. Indeed, had the building been of staff, and not of heavy, solid stone at its base, it must have gone up in smoke, while Electricity Building would have been imperiled. At first it was stated that the fire arose from a short circuit in the regulating apparatus and cables, but at it was midday when, so far as can be ascertained, no current was on and no apparatus running, there was suspicion at once of incendiarism on the part of discharged employees. The police investigation is said to confirm this theory of origin. Great energy is being shown in repairing the damage, but it is feared that a further delay of a few weeks must now occur before this part of the Exposition can be made operative, and the lovely Water Palace be seen at night as well as by day.

AUTOMOBILES are beginning to loom up in Transportation Building. There and at Vincennes, Lieut. Comdr. Baker, in charge of that section, reports, the Riker Company will have 17; Columbia, 10; American, 7; Overman, 2; Locomobile, 9; American Roller Bearing Company, 2, and Cleveland Machine Screw Company (Sperry), 10. The automobile exhibits are already a great centre of attraction, but it is feared that the recent stand against road racing, taken by the departmental authorities all over provincial France, will interfere seriously with the proposed long-distance road races that are part of the Exposition programme.

KEEPING TAB. The work of pushing American goods is being gone about in a very systematic way by the United States Commission, and it is well that such is the case, for the inquiries are already coming in briskly from visitors. Careful note is taken of inquiries, and the visitor is asked for name and address and as to the articles in which he is particularly interested. The result of such work is necessarily far-reaching, and, as might be expected, the representative American technical papers on the grounds are actively co-operating with the United States officials in this campaign of propaganda.

GETTING CURRENT has continued to be a problem for not a few exhibitors and concessionaires until the service plant is in full blast, and various means have been tried of meeting the difficulty. The storage battery has been an obvious means of relief where low voltage direct current could be used, and during the week not a few batteries have been brought into the grounds, it is said, to energize displays that otherwise were standing dead and idle, "eating their heads off."

Gasoline Automobile and Insurance.

The gasoline automobile is being investigated by insurance men in Indianapolis, Ind. A number of applications for permits for the storage of such automobiles in unused buildings have been granted and also a number refused. There is no rule covering or prohibiting them in the rate book, but as they carry from 5 to 10 gallons of gasoline, it is conceded that their storage increases the hazard of the risk. The matter has been submitted to the local board of underwriters, and it is generally believed that an extra charge will be required for a permit to store a gasoline automobile. It is cited that the largest fire of recent occurrence in Washington City was caused by an explosion of the gasoline of an automobile in the building where the vehicle was stored.

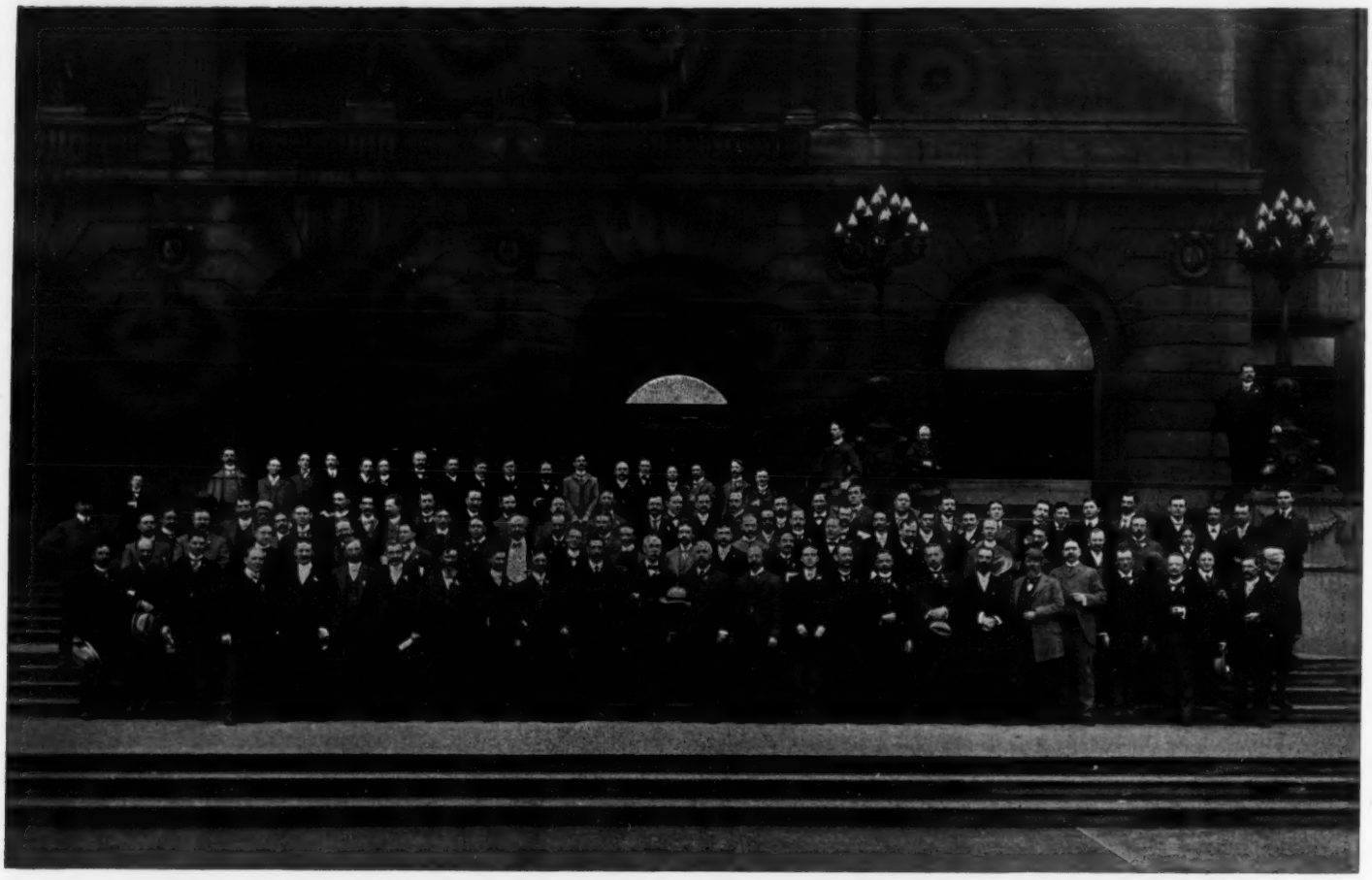
Chicago National Electric Light Convention.

THE annual meeting of the National Electric Light Association for 1900 exhibited a notable tendency toward attention to business, serious discussion of the topics presented and avoidance of trifling side issues and opinions not backed by positive knowledge. The convention was held in Chicago in exactly the same quarters as those occupied two years ago. On Monday evening, May 21, the reception opened the meeting, and proved notable for the large number of ladies present.

On Tuesday evening, the 22d, the first business meeting was called to order and addressed by President Carnes.

President Carnes congratulated the convention upon meeting in a city where the most advanced central-station engineering and practice is so well illustrated. He referred to the great differences in metropolitan central-station work and that of installations of the smaller cities, one of the latter of which he represented. Referring to his selection as president, Mr. Carnes said that he highly appreciated the compliment, which he accepted as one to his section of the country, the South, and not to himself individually.

"My case is not so exaggerated, perhaps, but reminds be of the story of the country boy whose father took him to the city for the first time. He explained to this boy that there was a great difference between the manners and customs of the people of the metropolis and those in the rural districts, and while there he must see and hear all that passed, he must refrain from talking or engaging in conversation for fear it might be discovered that he was a green country fool. The boy, fully impressed with this advice, resolved to follow it implicitly. A good natured city gentleman observing the verdant hue of this somewhat remarkable looking young provincial, was curious to know something of his origin and history, and undertook to engage him in conversation. He applied a number of questions, and while the boy looked rather intelligently at him, he made no answer. Then the man asked him, "Are you deaf and dumb?" The boy shook his head, but answered not a word. "Then you must be a fool," said the man. "There now, dad," cried the boy, "they have found me out already, and I never opened my mouth." Your indiscreet indulgence of this compliment at the expense of your better judgment constrains me to confess that I became sufficiently inoculated with that same unaccountable nerve to seriously entertain the idea of making an effort to deprive you of the advantages of meeting in Chicago by calling this session in my own native city of Memphis, with naught to recommend it but its natural Southern hospitality; warm as its summer sun, genuine as its native corn juice, and as refreshing as its world-renowned mint; the combination of which has the happy tendency to produce an absolutely irresistible power factor in the establishment of fraternal affection and brotherly love. A more mature reflection, however, convinced me that I would have to deprive myself of the pleasure of showing you the livest city in the South, by consulting your better interests and coming to Chicago, as originally intended. In this I am sure we have lost nothing, for I find that the wideawake, up-to-date, progressive, wholesouled, all-around good fellows of the electrical fraternity here have, with their usual enterprise and accustomed hospitality, made every provision for our entertainment and pleasure; and when the programme is announced, I predict that the power factor of good fellowship will be so fully established with the same high efficiency which has always characterized this famous city, that we will be unanimous in offering the least possible resistance."



SOME OF THE DELEGATES TO THE CHICAGO CONVENTION.

The first paper taken up was the "Report of the Committee for Investigating the Photometric Values of Arc Lamps." Mr. Henry L. Doherty, chairman of the committee, introduced the report, giving the objects sought by the committee, which were investigations of the relative merits of various makes of direct and alternating-current enclosed arc lamps, as well as the relative merits of the two different classes—direct and alternating. Investigations were also laid out to cover the absorption of different kinds of globes and of carbon deposits in the globes. It was also planned to determine the relative effects of various kinds of out-door electric illumination.

Up to the present time only the first of these investigations have

been completed. Lamps were obtained from ten manufacturers, and carbons from three makers or importers. The work was carried on in the electrical laboratory of Purdue University.

Prof. W. E. Goldsborough presented the report of the treasurer of the committee, showing that the National Electric Light Association had appropriated $390, and that $434 more had been collected by the committee from other sources. With the exception of a balance of $63, these amounts had been expended for necessary supplies and labor. An abstract of the report appears elsewhere in this issue.

The committee was thanked by the association for its work, and was requested to continue the other investigations, which it had not as yet undertaken. The question of funds for the continuance of this work was referred to the executive session. Mr. H. A. Wagner called attention to the fact that there is great need of a standardization of enclosed arcs. In series open arcs we have standard so-called 2000-cp and 1200-cp lamps which are universally recognized as taking 9.6 amperes and 6.8 amperes respectively. But in enclosed arcs no attempt has been made to adopt standard powers. The alternating arcs as sold, are usually of smaller power consumption than the direct-current arcs, although a greater wattage is necessary in the alternating to produce the same candle-power. For instance, the average consumption of the direct-current arcs mentioned in the paper is about 525 to 550 watts, while the alternating arcs only consume about 450 watts. To make a fair comparison between the two this condition should be reversed, if anything.

Prof. Matthews explained this difference as due to the power factor of the alternating lamp, which calls for a greater current than the direct lamp to give the same wattage.

Mr. Gilman stated that 7½ ampere alternating constant-potential lamps are on the market consuming 480 to 500 watts at terminals. Twenty-five of these lamps have been tried in Atlanta for three months and compared with 800 ordinary naked arcs. The Board of City Lighting of that city has now approved arrangements to put in some 700 of the new lamps. In Pittsburg the Monongahela Company has placed an order for 1000 of the same large power lamps, which have also been put up in St. Louis to the extent of 1000 to 1500. Of the 125 stations which have adopted alternating arcs, about 115 have used the smaller powers, but the larger stations have chosen the more powerful type.

Mr. Gilchrist, of the Chicago Edison Company, disputed the arguments for a high-watt standard, contending that what is generally wanted is a lamp of smaller power consumption, such as 350 watts. In direct-current work his company finds a tendency toward the smaller candle-powers. One consumer using 250 lamps has them all of the 3-ampere size, and there is a great demand for the 4-ampere lamp.

Mr. H. H. Wait discussed the importance of considering the subject from the standpoint of the distribution of illumination, rather than the standpoint of candle-power. If the minimum illumination at mid-distance between lamps is made the criterion of value, all arguments will favor greater distribution of the light sources, which can best be obtained by incandescent gas lighting. In series street lighting the different angles of greatest intensity with different types of lamps seem to favor the use of direct-current open arcs for work with short distances between lamps; direct-current enclosed arcs for distances of about 300 ft. between lamps and alternating enclosed arcs for greater distances. However, the advantage which the direct-current lamp might have as a source of light is partially or wholly counterbalanced in series work by the comparative low cost of generating and distributing alternating current.

With these remarks the discussion of this subject closed, and the forenoon session was adjourned.

TUESDAY AFTERNOON SESSION.

The first paper presented in the afternoon was one by Harry J. Frith, of Watseka, Ill., on "Exhaust Steam Heating." The paper advocated a hot-water heating system, the water to be heated by exhaust steam. For use in case of insufficient exhaust steam, a separate live steam heater was recommended, which could also serve to raise the temperature of the outgoing hot water above 212° F. in extreme weather without imposing back pressure on the engines. The centrifugal or blower type of pump was recommended for circulating the water instead of the direct-acting type, on account of the better steam economy of the former. Taking up the distributing system, the paper continued to say that the services may be put in multiple with each other (to borrow an electrical term) between a supply and a return main, such an arrangement being termed the "two-pipe" system. Its disadvantages are the tendency of the nearest services to short-circuit those most distant from the source, and the consequent necessity of a high pressure between the supply and return pipes. The "single-pipe" system, in which all services are in series with each other, was recommended as preferable and cheaper and less wasteful through radiation. The open and closed systems were compared with each other the former having an open topped receiving tank at the incoming end of the return pipe. If, with such a system the station is below the services, the pumps will have to work between atmospheric pressure on the suction against the full head of the distributing system. With a closed system the pumps only have to work against the frictional resistance of the mains. The advisability of hot-water storage tanks was doubted.

Mr. F. A. Copeland added to the paper a talk on the system which his company has put in at LaCrosse, Wis. The system is the Yargan, which is two-pipe, and about 33,000 ft. of 8-in., 7-in. and 5-in. pipe have been put in; that is, about 16,500 ft. of supply and the same amount of return piping. This supplies at present 39 customers scattered up to a maximum distance of one and a quarter miles from the station, the pipes being large enough for a much greater number of consumers. There is no pressure on the return pipe, and 45 lbs. per square inch on the supply to lift the water to the highest radiator, about 100 ft. above the station. About 600 to 700 square feet of radiating surface are installed for a ten-room house, sufficient to heat the same to 70 degs. F. in 30 degs. below zero weather with water at 190 degs. One square foot of radiating surface is put in per 35 cubic feet of volume to be heated. The average drop of temperature between the supply and return is 35 degs. The loss by radiation in the mains is estimated at 6 degs. The electric light plant is condensing, and usually one-half of it is so run. There is a day load of about 150 horse-power, running up to 550 horse-power or 600 horse-power in the evening. Without a day load, Mr. Copeland doubts the advisability of a heating system. A thermostat and automatic valve is required in every service to prevent waste of heat. It is found that if the temperature of the water is raised, the pump soon slows down, owing to the closing of the thermostats. The temperature of the water is graduated according to the severity of the weather. No trouble has been experienced in giving sufficient heat. Trouble has been experienced from the pilfering of hot water through the air cocks. To prevent this, the water is to be covered. The mains are laid in a triple box of hemlock lumber, giving two air spaces. Mineral wool is placed around the pipe inside the innermost box. The company is going to put in an induced-draft system and pass the gases from its boilers through hot water heaters on the principle of an economizer. In answer to questions, Mr. Copeland also gave data as to costs and revenue, which he did not wish published.

Following Mr. Copeland's talk and answers to questions, the paper on "Central Station Economies" was read by Mr. W. L. Abbott, chief operating engineer of the Chicago Edison Company. This paper described methods of lubrication, of firing, of measuring the quality of flue gases, of proportioning the number of men at work to the load, and so forth, as adopted by the Chicago Edison Company, all tending to the most economical production of power.

In the discussion, Prof. D. C. Jackson stated that in small central stations a reasonably good fireman can get 8 per cent of carbon dioxide, whereas the average probably do no better than 5 per cent. Mechanical stokers ought to show a higher percentage of CO_2 than all but the very best of hand firing, but have been seen doing no better than 2 per cent. Mr. H. L. Doherty mentioned the fact that abroad it has been found possible with a fire 44 ins. thick to so regulate the blast as to obtain 90 per cent of the full theoretical amount of CO_2. For load variations with a blast maintained at best speed for fuel economy it might be possible to make the blast intermittent, just as the steam admission is made intermittent in the Parsons steam turbine. Mr. Doherty moved the appointment of a committee to determine the best methods of flue-gas analysis.

In answer to questions as to the method of gas analysis by means of the econometer, Mr. Bement explained that the instrument consists essentially of a hollow glass ball suspended on a sensitive balance. Flue gases can be drawn around this ball, and will relieve its weight in proportion to their specific gravity. The specific gravity of CO_2 being 1.52 and that of other constituents about the same as air, the greater the amount of CO_2, the greater will be the floating effect on the glass ball.

The next business on the programme was the report of the Committee on Standardization of Electrical Apparatus. This report,

which was read by Prof. Robb, recommended the approval of the report made by the corresponding committee of the American Institute of Electrical Engineers, and stated that the Institute committee is working with a committee of the American Society of Mechanical Engineers to secure a standardization of sizes, speeds and armature losses of direct-connected engines and generators.

The report of the committee was approved, after which the meeting adjourned.

WEDNESDAY MORNING'S SESSION.

The meeting opened Wednesday with the reading of the paper on "Uniform Accounting," by Mr. J. B. Cahoon, of Syracuse, N. Y. This paper points out the inevitable alternative of municipal ownership or public regulation. To avoid the former the latter should be permitted or even encouraged. The best check to municipal ownership is a correct public exposition of the financial status of operating companies, which would show that they as a rule are not making 50 per cent or 25 per cent per annum, but simple interest on their investment with a fair profit for the risk taken. The paper gives the correspondence between the association and the League of American Municipalities relative to an investigation of municipal plants by expert accountants. To meet the need of a uniform system of accounting Mr. Cahoon's paper outlines a system which he has devised.

In the discussion of this paper the vexed question of depreciation came up and was treated at length by Mr. Samuel Insull, a few of whose remarks had the following bearing: If all new machines and apparatus are charged against construction and not against operation, a plant will indicate falsely a profit which will give a strong argument in favor of municipal ownership. When coal is purchased and used it is charged against operation; when a dynamo is purchased and used up it is consumed to just as great an extent as is the coal, and should justly be charged against the same account

There is no objection to the publication of accounts, there being everything to gain and nothing to lose, as the companies are not in a business of large returns. If the association could get a committee to show up accounting of central-station companies in the annual conventions, it would be a protection to all others against municipal agitation. The public should not believe that the companies are making 50 per cent profits. The companies should welcome enforced publication of their own accounts and those of municipal plants on the same basis. Mr. Insull also said that he personally had no objection to municipal ownership provided it was undertaken in such a way as to give the operating companies their money back and a fair return for the risk they had undertaken. The larger Edison companies have already brought their accounts to a common method so as to obtain a basis for comparison and rivalry which is mutually beneficial. Referring again to the question of depreciation, Mr. Insull was asked what he would do in case his company purchased a 50-light dynamo for $2,000 and used it for four years, at that time selling it for $250, and purchasing a 100-light machine for $4,000. In answer, Mr. Insull said that he would charge off $1,750 as depreciation against operation and $2,000 for increased capacity against the construction account. If no depreciation had been charged on the machine during its four years' use, and the whole charge for depreciation would be too heavy on one year, it might be carried as a special account over two and a half years or some such period ahead.

A resolution was introduced and passed providing for the appointment of a committee to formulate a system of accounting, this system to be printed and put in hands of members in time for perusal before the next convention.

The meeting then adjourned until afternoon of the same day.

WEDNESDAY AFTERNOON'S SESSION.

The first business transacted in the afternoon was the reading of the paper by Prof. W. L. Robb, of Hartford, Conn., on "Series Inclosed Alternating Arc Lights for Street Lighting Service. The paper describes the constant-current transformer system as adopted in Hartford, and compares it with several other systems.

The discussion was opened by Mr. H. H. Wait, of Chicago, who pointed out the fact that if minimum illumination in candle-feet is made the basis of contracts—as is sometimes the case—much more favorable results can be obtained with incandescent lamps, either electric or gas, than with arc lamps.

Mr. M. E. Turner, of Cleveland, described his experiences in this line. He visited Hartford, and decided that the alternating arcs gave as good illumination as direct-current arcs of the same wattage. Returning to Cleveland, he put up six arc lamps, two open direct current, two enclosed direct current and two enclosed alternating current, all of the same power consumption. Some 25 or 30 electric light men inspected these lamps, most of them feeling confident in advance that the direct-current lamps must give more light than the alternating. After they had seen the lamps, read by their light, turned them on and off and made similar tests, all but two of them decided that the alternating lamps were giving more light than the direct, either open or enclosed. Afterwards about fifteen alternating-multiple lamps were placed on one street, some with opalescent and some with clear inner globes. Obstructions midway between lamps with these two kinds of globes showed positively that the opal globes were giving more light than the clear globes. While near the pole the clear globe might give greater light at distances of 150 ft. and more, the opal globe gave the greater illumination.

Several speakers gave evidence showing that the Boston Electric Light Company can and does trim with one man and a horse and wagon 600 enclosed arcs at an annual saving over the cost of trimming open arcs of $10 per lamp per year.

Mr. H. W. Hillman, of Schenectady, N. Y., stated that the Utica Electric Light Company claimed a saving of $9.74 per lamp per year over cost of trimming open arcs. One trimmer now takes care of 600 lamps, requiring six men with the old form. The company has put into use a revolving brush for washing the inner globes that saves considerable time; this and other details reducing the cost of trimming to $1.28 per lamp per year.

The general opinion of the remaining speakers seemed to be that the alternating arc gives most efficient horizontal light, which is of value in street lighting, and that the alternating series arc gives a great saving of first cost and losses between the engine and the lamp as compared with other systems.

Following this discussion President Carnes appointed Messrs. H. L. Doherty, W. L. Abbott and D. C. Jackson as a committee for determining the best method of testing fuel gases. Messrs. Samuel Insull, Chas. R. Huntley and E. R. Weeks were appointed as the Committee on Nominations. A resolution was adopted favoring the legislation to establish a national bureau of weights and measures.

The paper on "Equitable, Uniform and Competitive Rates" was then presented by Mr. Henry L. Doherty. This paper outlines the objectionable features of flat rates, uniform meter rates, meter rates based on quantity of consumption, meter rates with a minimum charge, meter rates based on length of time maximum capacity of installation is used, weter rates varied by total time maximum demand is used, and meter rates varying according to time of day at which current is used. The requirements of an ideal system are then discussed in the light of reports of appropriate data from many stations. A new system of charging is described which will be immediately but in service in a central station. It is based on a charge for "readiness to serve," and an additional charge per kilowatt-hour consumed. The charge for readiness to serve is based on the maximum demand for which the consumer may wish to contract, and fuses or some interrupting device will be used to prevent exceeding this demand. There will be a fixed charge of $3 per consumer per year, in addition to $3 per meter per year; $1.50 per lamp demanded per year in addition to a meter rate of 5 cents per kilowatt-hour. The advantages of such a system are pointed out, and the claim is made that it would, if adopted, "prove a panacea for most of the ills to which the average central station is heir."

In the discussion, Mr. L. A. Ferguson rose to the defence of the Wright demand system, stating that about one-fourth of the income of the Chicago Edison Company is obtained on this system, showing an average discount of about 33 per cent. About 7 per cent of the consumers received no discount. A lower rate is made in summer than in winter. The inspection of the 6000 meters in Chicago amounts to about $60 per month. The system proposed by Mr. Doherty does not give a low enough rate to compete with large isolated plants where a rate of less than 4 cents per kilowatt-hour must be made; and, on the other hand, it is too high for residences. The effect of the Wright demand system in Chicago and Boston has been to broaden out the peak.

Following this discussion the meeting adjourned.

WEDNESDAY EVENING'S SESSION.

On Wednesday evening Mr. H. G. Reist, of Schenectady, N. Y., delivered a lecture on "Alternating-Current Generators," many points of which were illustrated with stereopticon views. The lecture traced the development of alternating machinery from the rotating armature to the rotating field type, described the construction of the lat-

ter adopted by the General Electric Company, and went on to a description and explanation of the principles of the compensated revolving field machine made by the same company. This machine has an exciter running synchronously with the generator, the voltage of the exciter being influenced by the output of the generator in such a way as to raise the exciter voltage as the load comes on, this rise of exciter voltage being greater for an inductive than for a non-inductive load, thus automatically compensating for the greater demagnetizing tendency of inductive loads.

THURSDAY MORNING'S SESSION.

The first business presented to the convention on Thursday morning was the report of the Committee on Standard Candle-Power of Incandescent Lamps, which, together with the several other committee reports, are given below:

REPORT OF COMMITTEE ON THE STANDARD CANDLE-POWER OF INCANDESCENT LAMPS.

The committee reported though a number of stations are now demanding a range of candle-power of from 15 to 17, instead of from 14½ to 17½, as previously adopted, and that while it believes that such a course of classification is desirable, it is not prepared to definitely recommend it until proper standards and apparatus have come into more general use than at present.

Earnest attention was directed to the measure now pending before Congress for the establishment of a National Standardizing Bureau, corresponding in its functions to the German Reichanstalt, and which would be able to furnish authoritative standards to all who should desire them. The committee recommended that the National Electric Light Association as a body endorse the establishment of such a standardizing bureau, and communicate its endorsement to the House Committee having the matter in charge. In the opinion of the committee such a source for standards of light will be much more satisfactory and authoritative than anything which could otherwise be obtained, and that its value to the association and to the art in general can hardly be overestimated.

Pending the establishment of such a Government institution, the committee has arranged to have standard 16-cp lamps of 110 and 220 volts, prepared at Columbia University, New York City, in pursuance of the committee's specifications. These lamps will be furnished in pairs at the cost of preparation, to such members of the National Electric Light Association as may desire them, and orders may be placed with the secretary of the association for such standards, which will be put through as promptly as possible. The general method of standardization of these lamps will be that laid out in the report of the American Institute of Electrical Engineers on the subject.

With respect to photometric apparatus and methods, the committee reported that it is preparing for publication a specification and drawings for a standard photometer room and its equipment, and has under construction a standard form of simple photometer. During the past year the forms of standard and portable photometers which are now on the market have been examined, and while some of them are capable of giving excellent results, it was deemed wise to furnish specifications for a somplete photometer room in which other photometers can be installed, together with directions for their use in such manner as to obtain from them the best results. It is recommended that the standards should be run when practicable from a storage battery or other steady, separate source of electromotive force, obviating as far as possible the need of rheostatic control of the standard lamp. When such a source is not available, the standard lamp to be tested should be operated off the same circuit with a proper rheostat for bringing the voltage of the standard to its rated value.

With respect to methods of use of photometers, attention is emphatically called to the fact that photometers must be put in working adjustment by rotating the standard lamp at its rated voltage in the place that during testing will be occupied by the lamps to be tested. Photometers based on a fixed position of a standard lamp in which this precaution is not observed, we deem to be unreliable on account of errors of screen and personal errors which can only be eliminated by treating the standard and lamps to be tested in precisely the same manner.

Attention is also called to the desirability of investigating carefully the candle-power scales, and the rheostats arbitrarily controlling the voltage in some forms of photometers now furnished. They are immensely convenient when in adjustment, but should not be used without testing their adjustment.

At the present time the committee considers that the rotation of the lamp on the vertical axis is sufficient, although when lamp filaments are of more uniform characteristics than at present, arrangements for measuring zonal distribution of light may be desirable. It believes that the time has come for careful photometric tests of all samples, rather than for merely maximum and minimum tests, since lamp manufacture has so far advanced that if the maximum and minimum tests only were to be used, there might be a strong tendency on the part of the manufacturer to work towards the inferior or superior limit.

With respect to uniform wattage of lamps, at a given rated candle-power, the fact is recognized that the desire of stations as to closeness of wattage-rating varies somewhat, but the committee earnestly recommends that no variation from the nominal wattage of a 16-cp lamp greater than 2½ watts on either side of such rating should be permitted.

With regard to method of sampling, the testing is recommended of ten lamps taken promiscuously from each barrel, all of which must fall within the limits heretofore adopted by the association. Any lot of lamps not standing this test should be totally rejected, and any scheme permitting a greater variation can be productive of nothing except bad lamps. This sampling should be supplemented by test burning of lamps to determine their qualities with respect to life, but at the present time the art is not in such state as to justify recommending any uniform and definite standard, although such recommendation should form a subsequent part of the work of the committee.

Finally, the desirability is urged of members of the association supplying themselves with standard lamps, which can in the near future be ordered at any time through the secretary, and it was added that shortly there will be forwarded through the secretary to all members a copy of the specifications above referred to.

REPORT OF COMMITTEE ON GROUNDED CIRCUITS.

The Committee on Grounded Circuits opened its report with a feeling tribute to its late chairman, Lieut. S. Dana Greene.

The difference of opinion as to the "grounding of the neutral wire" in direct-current, three-wire, low potential systems was referred to. Some very eminent professors, nearly all fire-insurance officers and inspectors, and some prominent workers in the electrical field, have argued against it as being an extremely dangerous practice, and one that would be sure to increase the fire hazard and render the business of fire insurance less profitable. Others, less prominent perhaps, but having more practical experience with the actual operation of three-wire systems, took the opposite ground, believing no harm could result from the grounding of the neutral wire outside buildings supplied therefrom.

Nearly all fire insurance boards have issued their edict against this practice; but, notwithstanding their opposition, it is now almost the universal practice to permanently ground the neutral wire. Experience has shown that this practice has not increased the fire hazard or losses by fire, but, on the contrary, it is fair to presume that it has decreased both hazard and loss.

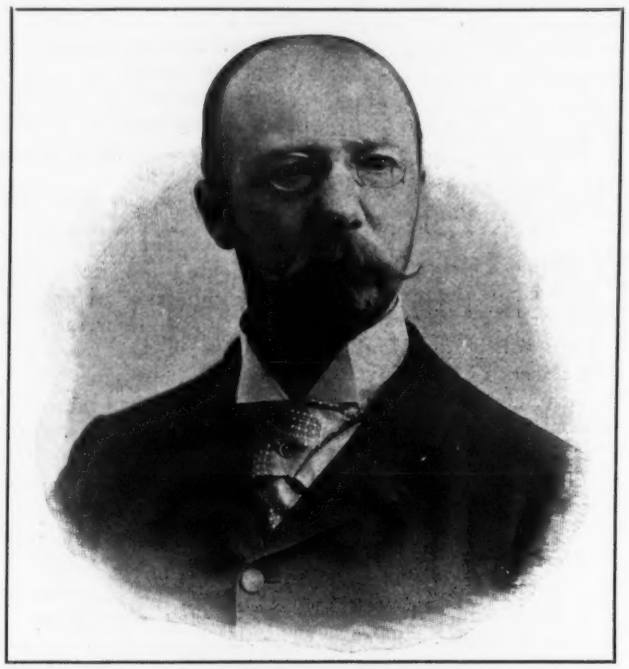
A three-wire system with lamps, motors, etc., in multiple, whether overhead or underground, extending over a large area of territory must, owing to bare connections in the case of underground feeders and mains and on overhead conductors an insulation that is not impervious to moisture, offer a very low absolute insulation resistance. And, as a matter of fact, leakage to ground over the entire system cannot be prevented. Such being the case, the committee considered that the "grounding of the neutral" is a very great measure of safety, and by no means a menace to property by increasing the fire hazard. Little need be feared from low-resistance grounds, and by grounding the neutral the danger from high-resistance grounds is reduced 50 per cent, because the difference of potential between positive and negative conductors and the ground is the same as that between those conductors and the neutral. Again, so long as a high grade of insulation is maintained on wires, fixtures, etc., within the walls of buildings, little danger need be apprehended from the failure of the insulation of the feeders and mains on the outside, whether they be overhead or underground. The highest grade of insulation of interior conductors should be insisted upon by every station manager, and current should not be supplied to any system of conductors, the absolute insulation of which is not all that it should be. Strict attention to this very important matter will result in a very great reduction of the number of fires honestly chargeable to electrical causes.

As the matter of grounding one side of secondary circuits in transformer or alternating systems is now and has been occupying the minds of the members of this association and others who claim to be equally interested for a number of years, the committee has given this matter its attention.

From the time of the introduction of the transformer system fears have been entertained by a great many that accidents to persons and destruction of property would result from the failure of the insulation between the primary and secondary coils of transformers. To some extent such fears have been realized, as deaths and fire have resulted from the passage of the primary current over the secondary circuits, and in each case which the committee has investigated, no evidence of an escape of the primary current over the secondary mains was given by an increase of candle-power of the lamps or otherwise until fatal accidents occurred; then, and not till then, was it known that the insulation between the primary and secondary coils had failed.

Various plans have been proposed and devices tried to prevent accidents from this cause, the most effective step being the improvement of the insulation of the transformer. The "grounding" of the outer case, connecting the middle of the secondary coil to "ground," and a "grounded" magnetic shield, have all been tried to some extent and with varying degrees of success. Where transformers are placed in manholes and connected to underground lead-covered cables, the case can be securely grounded to the lead covering of such conductors; but when they are placed on poles, structures, roofs and walls of houses ,it is very difficult, if not impossible, to connect either coils or case to a good and secure "ground." Could this end be gained the liability of breaking the ground wire would be very great, and when broken such wires would be a source of danger.

The committee states that no magnetic electric device for automatically grounding the secondary in case the high potential current passes over the same known to it has thus far proved reliable. That type that is constantly in circuit owing in their almost constant consumption of energy are objectionable, while those that depend on a sudden increase of voltage are unreliable. While the committee considered that the permanent "grounding" of side of the secondary circuit is not an absolute preventive of accidents to person and property yet they firmly believe it is a step in the right direction, and if adopted will add greatly to the safety of the public and reduce the hazards attending the transmission of electrical energy by what is known as the alternating or transformer system.



LIEUT. JAMES BLAKE CAHOON,
PRESIDENT NATIONAL ELECTRIC LIGHT ASSOCIATION.

REPORT OF COMMITTEE ON FREIGHT CLASSIFICATION.

The Committee on Freight Classification reported that after numerous interviews and voluminous correspondence with the Central Traffic Association at New York, it received the same definite answers which were embodied in its report last year, namely, that the railroads did not see their way clear to harmonize the classification of electrical apparatus with that of other merchandise.

The committee stated that it sees no possible hope for justice at the hands of the representatives of the railroad companies by any application from it. The Interstate Commerce Commission has expressed a willingness to listen to its statements, but has coupled with that expression the statement that it is powerless to do anything but make a recommendation, as it had no power to act or to compel the railroads to take action.

That a condition exists that is grossly unfair to the electrical interests is realized by every manufacturer. The committee suggested that the matter be taken up in the United States courts, and recommended the employment of suitable counsel to this end as being the only possible remedy to-day. The committee is satisfied that the association will be justified in submitting the case to any competent attorney on the grounds of unjust discrimination, and has every reason to take the step recommended by the committee.

REPORT OF THE COMMITTEE ON STANDARD RULES.

The Committee on Standard Rules states that during the past year it has continued to discountenance any changes in the national code of rules not absolutely necessary; but with the march of improvement in the electrical field some changes therein and additions thereto have been found necessary since the issue of 1897.

The policy heretofore pursued by the insurance organizations of sweeping out of existence thousands of dollars' worth of material that had been used previously with the sanction of insurance inspectors has been abandoned, and while new and better devices and material are substituted an opportunity is offered the manufacturer, dealer, contractor and station manager to sell and use the material and fixtures on their hands.

The thickness of interior conduit, lined or unlined, has been established, and commercial gas pipe taken as the standard. "Weatherproof" wire, so called, is tabooed for interior construction unless covered with a slow-burning material. A standard of thickness of insulation on wire, after a conference with the manufacturers, has been established.

The much-vexed question of the proper distance between fuse terminals has been determined, as well as the distance between fuse metals of opposite polarity. Switches are now being standardized as to the proper breaking distance between poles, etc.

The rules have been changed so as to permit the running of two or more small motors in series multiple or multiple on constant-potential circuits. Rubber insulation is not now insisted on for flexible cord pendants in dry places, but an elastic, slow-burning material may be used. Rule 40 has been so amended as to permit in dry places the use of a slow-burning insulation similar to what has been known in the past as "Underwriters."

The next matter taken up was the paper of Mr. Elmer E. Sperry, of Cleveland, Ohio., on "Automobiles as a Source of Revenue to Central Stations." In the absence of Mr. Sperry, Prof. G. F. Sever read the paper, which called attention to the fact that the electric automobile has not met expectations in improving the load curve of central stations. This was explained as due to the fact that vehicles are commonly charged during the evening—the time of heaviest lighting load; they take more power in bad than in good weather, and, as a rule, call for more power in winter than in summer. The paper proposed that duplicate batteries be provided to remedy these points. The question of automobiles versus street cars was taken up, and stated to depend largely on the roadbed. The use of convict labor for improving roadways was proposed.

There being no discussion on this paper, Mr. R. S. Feicht, of Pittsburg, read his paper on "Combination Electric Lighting, Power and Railway work." This paper traced the history of power-station work from the beginning down to the present stage of large alternating systems with sub-stations, and outlined the various possible combinations of direct and alternating-current machinery.

The meeting then went into executive session.

There was a very general discussion on the subject of free wiring. The principal participants were Mr. Charles R. Huntley, of Buffalo, N. Y.; Mr. E. L. Bemiss, of New Orleans, La., and Mr. Dudley Farrand, of Newark, N. J. A wide diversity of opinion was expressed on the subject, but the general consensus of ideas was that the question of free wiring should be controlled by the individual circumstances of each special case.

Mr. Samuel Insull presented the report of the Committee on Legislative Policy, which brought forth considerable discussion.

The Committee on Nominations presented its report as follows: President, James Blake Cahoon, Syracuse, N. Y.; first vice-president, Louis A. Ferguson, Chicago, Ill.; second vice-president, W. Worth Bean, St. Joseph, Mich. Members of the executive committee to serve until the close of the twenty-sixth convention: Charles B. Hunt, London, Ont.; Ernest H. Davis, Williamsport, Pa.; Henry L. Doherty, St. Paul, Minn.

The secretary cast the ballot of the association for the members nominated, and the gentlemen were duly declared elected.

Mr. Cahoon was escorted to the platform by Messrs. Samuel Insull and Charles R. Huntley, and was introduced by Mr. Carnes.

Mr. Cahoon responded as follows: "I suppose when a newly elected president takes the chair he is expected to make a speech. I only want to say one or two words with reference to the work which has come up in this convention. The work outlined for the coming year is such that I do not believe the president of the association is going to have quite as easy a time of it as he has had in the past. We have taken up the subjects of accounting and of meter rates, and these two matters it seems to me should be pressed forward to completion. The question of cost is an important one. In view of what Mr. Huntley said, which I think is borne out by many of the companies in other sections of the country—that only 23½ per cent of the electric light companies in New York State are paying dividends—the question of the determination of the cost of our product certainly deserves more consideration than it has been given in the past.

"Another point that seems to be forging rapidly to the front is the question of municipal ownership. In December of this year the American League of Municipalities meets in Charleston, S. C., and in the meantime we have to formulate some plan whereby we can secure what we went after last year, namely, the co-operation of the league in the determination of costs of municipally operated plants. That seems to be in general an outline of the work to be taken up.

"I want to say a word in regard to the use of the offices of the association in New York. Last year I suggested that when the smaller plants were making changes in their systems, as many of them are doing, that they send to the secretary of the association a plan of their changes. Many of the small plants cannot afford to employ electrical engineers to design their work for them, but they do need the assistance of the association in such matters as these. I am in hopes that this suggestion will be taken to heart. Gentlemen, I thank you very much for the honor you have conferred upon me in electing me as your president."

Brief remarks in acknowledgment of their election were made by Messrs. Ferguson, Bean, Davis and Doherty.

The report of the secretary and treasurer was read, showing the following financial transactions during the year:

Total receipts, including balance on hand at last report	$9,273.15
Disbursements during the year	4,904.60
Balance on hand, including special funds	$4,368.55

Retiring President Carnes addressed the meeting, as follows: I wish in retiring from the presidency to express my high gratitude for the high compliment you paid me in my election, and especially for your patient indulgence with my shortcomings and lack of ability to serve you as our former presidents have done. While I have done the best I could, I realize fully how little that has been, and I am very grateful to you for your kind indulgence.

The convention then adjourned.

CONVENTION NOTES.

THE UNITED STATES CARBON COMPANY had a display of its carbons.

WIRT ELECTRIC COMPANY showed its rheostats and theatre dimmers.

THE ELECTRIC APPLIANCE COMPANY had the Gutmann wattmeter on exhibition.

THE HELIOS-UPTON COMPANY showed a line of batteries, switches and enclosed arc lamps.

THE JEWELL INSTRUMENT COMPANY displayed portable and switchboard ammeters and voltmeters.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY had a good display of its enclosed arc lamps.

THE WARREN ELECTRIC & SPECIALTY COMPANY showed a line of Peerless transformers and fan motors.

THE H. W. JOHNS MANUFACTURING COMPANY exhibited its Noark fuses and Manville magnesia coverings.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY had one of its latest types of wattmeters on exhibition.

QUEEN & COMPANY had a very interesting exhibit, comprising their portable photometer, ammeters and voltmeters.

THE GENERAL ELECTRIC COMPANY did not make an exhibit, but had the large parlor of the hotel, where its representatives received its friends.

THE PERU ELECTRIC MANUFACTURING COMPANY had a very interesting line of new fuses, transformers, rosettes and a fuse plug for heavy work.

THE WESTERN ELECTRIC COMPANY displayed its arc lamps, fan motors and ceiling fans. Throughout the hotel, W. E. "Petite" enclosed arc lamps were in service.

THE STANDARD PAINT COMPANY had samples of its P. & B. compounds and tape. It was not possible to make a striking display of these goods, but the Standard people made up for it by distributing a very handsome souvenir pocketbook.

THE SPRAGUE ELECTRIC COMPANY had an extensive exhibit of Lundell fan motors, and its "Greenfield" flexible, steel-armored cable, and steel-armored flexible cord. A number of Lundell fan motors were in operation throughout the hotel, performing a service which was highly appreciated by the delegates and their friends.

THE BELDEN-LARWILL ELECTRIC COMPANY exhibited its 110-volt, 220-volt and other types of lamps on a very unique display stand, made of copper lamp cases, which was very effective. Mr. Belden was in charge of the exhibit, and explained carefully and lucidly to all comers the mechanism of the lamp, which attracted a good deal of attention.

THE FORT WAYNE ELECTRIC WORKS had an exhibit of "Wood" system arc lamps and rheostats. It also showed a Sawyer-Man semi-enclosed arc lamp, made 22 years ago, which, placed alongside its present lamp, showed in a very interesting and instructive manner the progress which has been made in the construction of lamps since that time.

THE SPLICE & TERMINAL COMPANY, of New York, exhibited a radically new device for splicing wires without solder. The ends of the cable are first stripped of insulation and inserted into a sleeve of copper, which by means of a portable hydraulic press is swaged around the cable ends. The dies of the press and sleeve are proportioned so that the result of this operation is to reduce the diameter of the sleeve, thicken its wall and consolidate the wires of the cable into a compact mass. It is claimed that the splice is oil and moisture-proof, and mechanically has greater strength than the cable at other points, while the conductivity of the joint is about 40 per cent greater than that of the cable. The exhibit attracted much attention on account of its novelty.

THE GENERAL INCANDESCENT LIGHT COMPANY had the largest display of any of the exhibitors, comprising Paragon fan motors, push switches, knife switches, removable fuse holders, panel boards, wright discount meters, arc lamps for all circuits, incandescent lamps of all kinds, Tailleur underground apparatus, plugs and safety fuses, rheostats, circuit-breakers and rotary transformers for telephone and medical work. It also exhibited a power motor of a new and very neat type, being of the same design as the Paragon fan motor, and made in sizes up to one horse-power. The same general design is used for a multipolar motor of from one to 10 horse-power. Outside in the hall was displayed a sign with a new lamp especially designed for sign work, which screws into a socket also of an especial design, rendering it water-tight. At the Chicago Edison Company's plant, the G. I. Company showed a complete series alternating arc-lamp system.

IN THE PAST one of the interesting and instructive features of most N. E. L. A. conventions has been the exhibits of the manufacturers who cater to the wants of the members of the association. The manufacturers who exhibited at the recent convention at Chicago had had absolutely no encouragement, as they were given no opportunity to display their line, the only space available being bedrooms in the Auditorium Hotel. They were not even grouped on one floor, but scattered throughout the whole hotel in such a manner that the only way for visitors to find the exhibits was to start at the top floor and walk around the hotel looking for signs. In this way the average visitor probably saw about one-third of the exhibits. and, owing to the fact that most of the rooms were occupied as bedrooms, there was very little opportunity to show visitors the exhibits or to explain the merits of the goods.

Report of the National Electric Light Association Committee on the Photometric Value of Arc Lamps.

This committee, composed of Henry L. Doherty, W. E. Goldsborough and J. Q. Brown, presented a progress report at the Chicago meeting of the association last week. Through the good offices of Purdue University, La Fayette, Ind., the committee has been able to take advantage of the excellent laboratory facilities afforded by the School of Electrical Engineering in that institution, of which Prof. Goldsborough is the director.

In an accompanying report, Prof. C. P. Mathews, who performed the photometric work, gives a detailed description of the methods and devices perfected by him to minimize the errors and uncertainties arising in arc-light photometry. The most unique of these is the adoption of two mirrors instead of one to direct the light from the source to the photometer. These mirrors are placed on opposite sides of the arc, and, as a result, the illumination of the photometer disk is rendered fairly uniform. Thus the fluctuations, so troublesome when measurements are made in the usual way, with a single mirror, are greatly reduced. The color difference is also lessened by the use of a rotating, sectored disk of very small angular aperture. This diminishes the apparent illumination of both sides of the photometric field to a point where the color difference ceases to be troublesome. Another device for lessening the labor of the process and also the retinal fatigue is the recording drum. This has been already described, but in these tests it has been used with an electro-magnetic recorder, which somewhat enhances its usefulness. To test the efficacy of this combination of devices in eliminating errors peculiar both to the source and to the method, readings were made by a number of observers. These measurements show a very satisfactory agreement, demonstrate that the end sought has been accomplished and that personal and other errors are not greatly in excess of those met with in the photometry of steady and monochromatic sources.

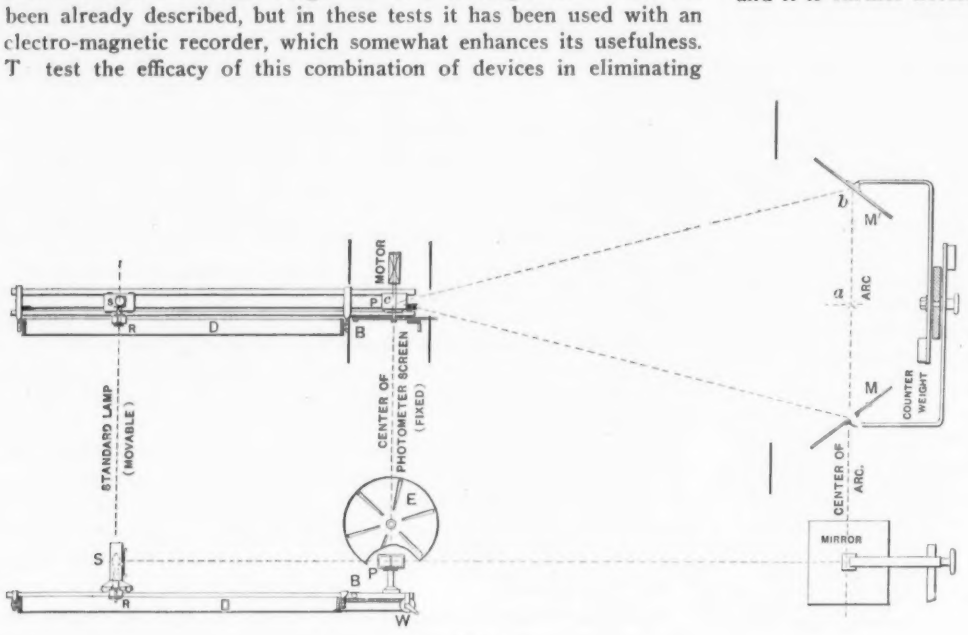


FIG. 1.

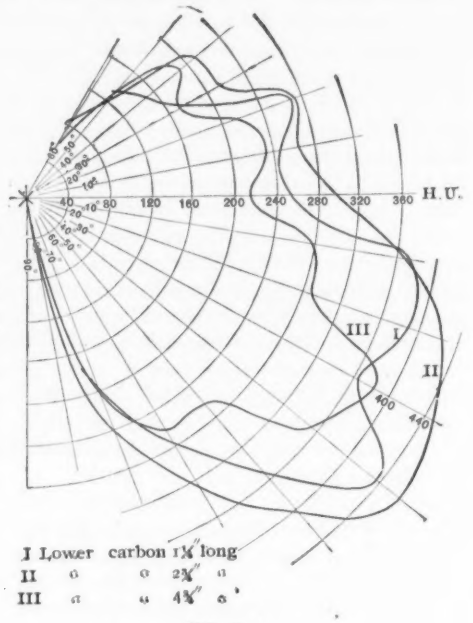


FIG. 2.

Reference to Fig. 1 will show the disposition of the apparatus as used in these tests. The two mirrors M, M' are mounted at the extremities of iron arms, and are suitably counterbalanced, as shown. The arc is fixed in the centre of rotation at a, and light is incident upon the photometer disk at c, by the two paths shown in dotted lines, direct light from the arc being cut out by a screen not shown in the figure. This plan necessitates a fixed photometer P, and, in order that a variable illumination may be produced to balance that due to the arc, a cord and windlass are arranged, W, permitting the observer to move with facility the secondary standard S, which is a glow lamp.

At D is shown a long wooden cylinder upon which is wrapped the paper to receive the records of the test. These records are made by an electro-magnetic device R, which punctures the paper whenever an electric circuit is closed at the button B.

The observer, seated before the photometer in a closely screened enclosure, operating with one hand the windlass, and with the other the push-button, is enabled to take settings with relatively great rapidity and accuracy. At a point 200 cm to the right of the photometer disk, a reserve standard is mounted on an arm which may be swung into a position in line with the bar. This reserve standard was carefully evaluated once for all in terms of the Hefner lamp. To determine the intensity of the secondary standard S, it is only necessary to turn the reserve into position, and record a series of readings in the same way as for the arc. This operation is carried out at the end of each test, or more frequently if any change has been made in the temporary standard. Thus, it will be seen that, should the lamp under test be found particularly weak at certain angles, the limit of the bar might be reached in the attempt to get a setting. In such case, it is necessary to stop down the temporary standard, and to again refer it to the reserve. It may be added that the reserve is never allowed to burn more than a few minutes, and cannot possibly deteriorate under such conditions of use.

With this disposition of the mirrors, the angle of incidence at the photometer disk is constant. In Fig. 1, this angle is shown at more than twice its actual value in order to reduce the length of the drawing. The real value of this angle was 5° —54′. To make a correction for this lack of normal incidence would mean the division of the intensities, as found, by the cosine of 5° —54′, or .9947. Failure to do this introduces an error of about one-half of 1 per cent, which is clearly negligible in work of this character.

It is, of course, necessary in testing sources with large globes or shades to use mirrors of size such that the globe or shade may be seen in its entirety when the eye is placed at the point C (Fig. 1); and it is further necessary that the distance $a\,b\,c$ should be large.

It is important to note that the double-mirror method, while enormously diminishing, the fluctuation due to wandering of the arc, can have no effect on such fluctuations as are due to variations in length of the arc, or to variations in the current.

A preliminary test of much interest is described as follows: "When an opalescent inner globe is used, the globe itself becomes more or less luminous by diffusion. The diffusion differs with the height of the arc in the globe; that is to say, with the length of the lower carbon. To ascertain the magnitude of this effect, I have carried through three tests on the same lamp and inner globe, and also the same carbons, the lower carbons being cut successively to the lengths of 4¾ ins., 2¾ ins. and 1¼ ins. The results appear in Fig. 2. In every case the arc was placed at the centre of the mirror system."

An inspection of these results shows that least light is obtained with the arc at the top of the globe, and most light when the arc is at the mid-point. This is explained in part by the fact that, with the arc at the top, a good part of the luminous flux is incident upon the non-reflecting surface of the gas cap.

While the second and third positions yield a considerably increased flux of light with a clean globe, they must be considered as impossible conditions in practice, since, by the time the arc has descended to these points, the globe has received a coating. The net result, then, as the lamp burns, is due to an increase in light flux due to the descending arc, and a diminution in light flux due to the formation of a coating. How this affects the quantity of light emitted, i e., the product of flux and time integrated through-

out the life of the carbons is a subject for future investigation, and involves the questions of carbons, shape of globe, etc.

In the tests, the initial condition, the simplest to obtain, was chosen, even though the light emitted may be less than at some subsequent period in the life of the carbons.

The first investigation taken up by Prof. Matthews was intended to settle the status of the 110-volt direct-current, enclosed arc lamp, as found in its commercial form to-day. Reports are made upon eight different lamps of this type. The tests were made upon the lamps as sent by the makers, but with a certain uniformity in conditions.

These conditions are:

1. The same brand of carbons throughout. 2. An opalescent or milky inner and a clear outer globe, as supplied. 3. An opalescent inner and an opal ground, or milky outer globe, as supplied.

Thus there are two regions where curve *II* extends beyond curve *I*.

Fig. 3 shows the results of a representative test on one of these lamps. The regularity and relative position of these curves are indicative of the accuracy of the methods employed.

The curves show very clearly the slight absorption of the clear outer, and the large absorption of the opalescent outer. The clear outer globe shows some diffusion, as it tends to round out the curve.

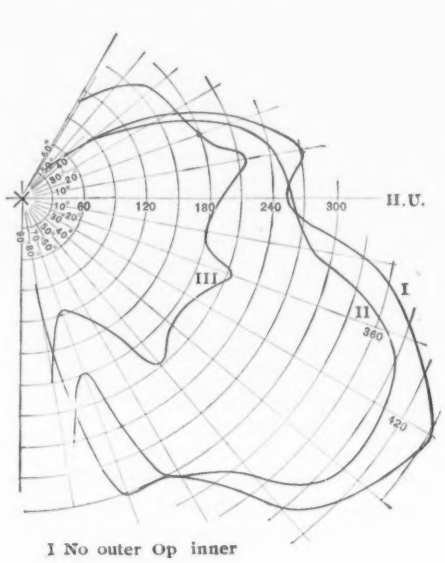
Hence the power required to produce one unit of light in this type of lamp is

Opalescent inner, no outer	=	2.10 watts.
Opalescent inner, clear outer	=	2.66 watts.
Opalescent inner, opalescent outer	=	3.04 watts.

Attention was called to the fact that these figures give the value of this type of lamp as a *light producer*, and not as a light *distributor*. The efficiency of the type as a distributor of light can best be found from a consideration of the curves of illumination—a matter which does not form a part of this investigation.

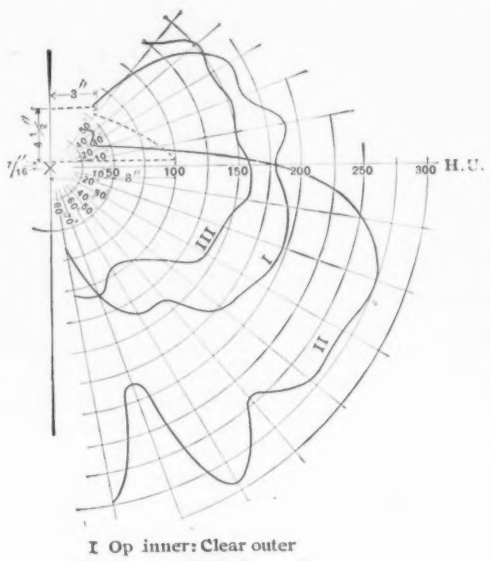
The second investigation reported deals with the general status of the 110-volt, alternating-current, enclosed arc lamp in its commercial form. Conditions similar to those described in the preceding tests obtained throughout this investigation. Seven lamps were subjected to tests. Of the results, none are more instructive than those obtained on lamp 106 (Fig. 4).

The highly beneficial effect of a shade on an alternating-current lamp is here well shown. The large upward lobe of the distribution curve is intercepted and turned into useful directions. It is to be remembered that these distribution curves represent the state of affairs when the lamp is newly trimmed. As the arc burns lower, the upward flux of light is strengthened and the value of the lamp



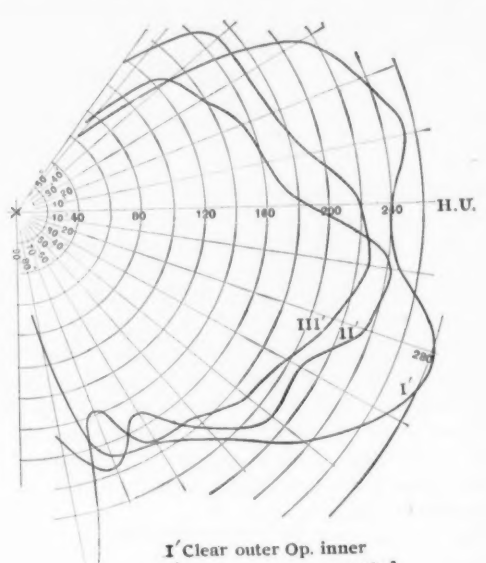
I No outer Op inner
II Clear " " "
III Op. " " "

FIG. 3.



I Op inner: Clear outer
II Op. " : Shade
III Op. " " Op. outer

FIG. 4.



I' Clear outer Op. inner
II' " " " " coated
III' Op. " " inner

FIG. 5.

In the case of the opalescent outer globe, the diffusion is so marked that the luminous intensity is practically constant throughout a very large solid angle. In the higher angles above the horizontal, the intensity is greatly increased, producing the effect, approximately, of a luminous sphere of equal intrinsic brightness. This results in the elimination of shadows, and the production of a pleasing light for interiors. The quality of light is also changed to a considerable extent through the absorption of the excess of violet rays otherwise very marked in the light of the arc. This result is attained, however, at a diminished efficiency. In this and nearly all the curves with the opalescent outer globes, a certain wavy outline is noticed. This effect is due, in large part, to the variations in the diffusive power of the globe itself. One finds difference in thickness and translucency to a considerable extent in such globes, and, as the angle of view changes, these differences would tend to distort the distribution curve.

At a common terminal e. m. f. of 110 volts, seven of these lamps take an average current of 4.90 amperes, which means an average total power consumption in each lamp of 539 watts. With 80 volts at the arc, this power is divided into 147 watts waste in the resistance coils and 392 watts in the arc. The average yield of light, expressed as mean spherical intensity, is:

Opalescent inner, no outer[1]	=	256 H. U.
Opalescent inner, clear outer	=	207 H. U.
Opalescent inner, opalescent outer	=	177 H. U.

[1]The Computations for no outer globe have not the same value as the others, for the reason that the number of such tests was less.

as a light source improves, because the shade then reflects a larger flux of light into useful directions. The shade in this case extends downward to a plane about one-half inch above the arc, when the latter is at its highest point. The horizontal intensity with shade is slightly less than with clear outer globe, showing that the latter strengthens this intensity by diffusion more than it reduces by absorption. The increase in intensity from the horizontal to 20° B is very marked when the shade is employed in the position here indicated, and these are angles of most importance in street lighting, if not in interiors. The mean hemispherical intensity is altered by the substitution of the shade for the clear outer globe in the ratio of 254 : 169, or 50 per cent increase.

It is worth noting that the curvature of this shade is admirable for the effect sought. A shade which is concave outwards will divert a portion of the luminous flux upwards, where it is largely dissipated by absorption.

As to the efficiency of this type of lamp, the following table gives a recapitulation of the power measurements on the alternating-current lamps. The mean power consumption of seven lamps is 417 watts. The average value of the mean spherical intensity is:

With clear outer globe	159 H. U.
With opalescent outer globe	130 H. U.

Therefore, as light producers, the average efficiency is:

With clear outer globe	2.62
With opalescent outer globe	3.20

In watts per mean spherical Hefner unit. The mean power in the arc is 342 watts, and in the mechanism, 74 watts.

ON THE RELATIVE MERITS OF THE DIRECT-CURRENT AND ALTERNATING-CURRENT LAMPS AS LIGHT SOURCES.

Regarding these lamps merely as light producers, the average direct-current lamp yields, with opalescent inner and a clear outer globe, 207 H. U., whereas the average alternating-current lamp for circuits of the same pressure yields 159 H. U., which gives the former lamp an advantage as a light source, irrespective of efficiency, in the ratio of 48 : 159, or 30 per cent. It is pretty well demonstrated that the alternating arc is *per se* less efficient than the direct-current arc. Just what the proper ratio may be is a matter for physical research, and varies with several factors, such as current density, wave form, etc.

Comparing the average performance of the lamps in the first series of tests with the average performance of the lamps in the second series of tests, one finds very nearly the same power consumption per light unit, viz.:

	D. C.	A. C.
Clear outer	2.66	2.62
Opalescent outer	3.04	3.20

The difference is slightly in favor of the alternating-current lamp in the first case, and somewhat more in favor of the direct-current lamp in the second.

To compare the direct-current lamp with the alternating-current lamp on the basis of mean spherical intensity is not always fair.

I Op. inner: Clear outer
II Op. " : Op. "
III Op. " coated : Clear outer

FIG. 6.

When an outer diffusing globe is used, this basis of comparison is correct enough, for the reason that the distribution of intensity is fairly constant in all directions, both for the direct and alternating-current types.

For outdoor use, however, lamps will be provided with inner globes only, or clear outer globes, or shades, as the case may be. In any event, the upward luminous flux which passes the globes or shades is practically of no utility. Hence, for out-door use, the mean hemispherical intensity below a plane passing through the arc is a better basis for comparison.

The average direct-current lamp in this series of tests yields a mean hemispherical intensity of 273 H. U. with clear outer globe. The average alternating-current lamp yields but 190 H. U. This gives the former an advantage as a useful light source represented by the ratio of 83 : 190, or 43.7 per cent. Moreover, the power required per unit intensity is in the two cases 1.97 watts and 2.19 watts per mean hemispherical H. U.; so that not only does the direct-current lamps with clear outer globes give a stronger mean intensity below the arc, but it does so at a higher efficiency. But it is wasteful to use an alternating-current lamp for street lighting without a shade or reflector. The tests on lamps 102 and 106 enable one to draw certain interesting comparisons.

They give mean hemispherical intensities respectively of 266 and 254 H. U., or very nearly the same as the average direct-current lamp with clear outer. This yield is obtained at a power consumption of only 418 watts, which is 1.61 watts per H. U. This emphasizes the great importance of a shade on the alternating-current lamp. Finally, comparing this last result with the performance of direct-current lamp 1, *with no outer globe* and no shade, the mean hemispherical intensity is 362 H. U., the power consumption 558 watts and the power per H. U. 1.54 watts. The conclusion based on this single comparison is that for street lighting, the direct-current lamp without shade gives 39 per cent more useful light than the alternating-current lamp with shade, and at slightly greater economy. The accompanying table gives the summarized results of the preceding investigations:

SUMMARY OF EXPERIMENTS.

No.	Current	Watts Consumed: In Lamp	In Arc	Mechanism	Mean Intensity in H.U. Spherical: Op. Outer	Clear Outer	Lower Hemispherical: Clear Outer	Mean Watts Per Spherical H. U.: Op. Outer	Clear Outer	Lower Hemispherical H.U.: Clear Outer
1	5.01	551	401	150	172	235 256*	332 362*	3.10	2.37 2.18*	1.66 1.52*
3	5.08	559	406	152	195	216	282	2.85	2.60	1.99
4	4.76	524	381	143	127	139	208	4.12	3.76	2.52
5	4.16†	458	333	125	154	174	221	2.96	2.63	2.07
7	4.76	524	381	143	203	233	317	2.63	2.20	1.65
9	4.84	532	387	145	182	226	281	2.83	2.38	1.89
10	4.99	549	399	150	202	242	309	2.74	2.24	1.77
12	4.87	536	390	146	178	195	230	3.05	2.66	2.33
	4.9	529	384	144	176	207	272	3.03	2.60	1.98

No.	Current	Watts Consumed: In Lamp	Power Factor Lamp	In Arc	Power Factor Arc	Mechanism	Mean Intensity in H.U. Spherical: Op. Outer	Clear Outer	Lower Hemispherical: Clear Outer	Mean Watts Per Spherical H. U.: Op. Outer	Clear Outer	Lower Hemispherical H.U.: Clear Outer
101	6.40	448	.63	340	.82	108	127	141	206	352	317	2.17
102	6.79	459	.61	375	.73	84	146	203 176†	236 266†	3.31	226 260†	1.94 1.72†
103	5.89	424	.65	344	.75	80	116	130	147	3.66	3.15	2.88
105	6.20	414	.61	382	.80	32	128	187	219	3.24	2.20	1.89
106	6.12	378	.56	298	.70	80	132	153 152†	169 254†	2.82	2.56 2.49†	2.23 1.48†
108	6.48	457	.64	383	.80	74.5	133	175	211	3.30	2.61	2.16
110	6.18	339	.49	276	.72	63	140*	126	143	2.41*	2.68	2.37
	6.29	417	.60	342	.76	74.5	130	159	190	3.31	2.66	2.23

*Condition of no outer globe. †Condition with shade on Lamp.
Note. All marked values, not included in the mean.

The report concludes with a description of certain preliminary experiments to determine the amount of light absorbed by the coating of ash formed on the inner globe of the enclosed arc, and the time law of its formation. But two representative examples of these measurements are here given. Fig. 5 refers to a direct-current lamp having a large inner globe of the closed-bottom type. Curve *I'* shrinks to curve *II'* in 106 hours, and the absorption is 16.6 per cent.

In Fig. 6, which represents the result of a coating test on an alternating-current lamp, one finds the striking result of *more light with coating than without.* The absorption is 12.5 per cent. It is important here to remember that, with the arc at the top, the strong upper lobe of the distribution curve of the alternating arc is very much curtailed. Now, as the arc lowers, this lobe unfolds, as it were. In 70 hours' time, the coating has not formed with sufficient rapidity to offset this increase in luminous flux. Hence the result shown.

Third Avenue Out of Receiver's Hands.

On May 23 Judge Lacombe in the United States Circuit Court consented to the withdrawal of the answer made by the Third Avenue Railroad Company in the suit brought last February by the Old Colony Trust Company, of Boston, Mass., and the vacating of the order appointing Hugh J. Grant receiver of the road, and Arthur H. Masten standing master of the court in the matters concerned with the litigation. He afterward signed the order removing Mr. Grant as receiver, and instructing him to restore the property to the company.

The application for the withdrawal was made by Edward Lauterbach, who appeared as a representative of the Third Avenue Company, which was said to be a solvent corporation now, and of the Metropolitan Company. He told about the securing of the $35,000,000 loan, and said that the uncontested claims, if the receiver should be withdrawn, would be paid on Friday. They amount to $17,000,000, and the contested claims swell the total to $23,750,000, which leaves

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about $11,000,000 in the treasury of the corporation after the floating debts shall have been paid.

It was agreed that all of the unliquidated claims presented during the pendency of the receivership, in case settlement was refused by either the Third Avenue Company or the Metropolitan Street Railway Company, should be sent to a referee for final adjudication.

It was estimated by some of the lawyers that Mr. Grant's fee of 1 per cent upon receipts and disbursements would amount to nearly $200,000. For the present, it is understood, no step will be taken to end Mr. Grant's receivership of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railroad.

At 11 o'clock a. m., May 24, Receiver Grant delivered the Third Avenue Railroad to H. H. Vreeland, president of the Metropolitan Street Railway Company. The formality of turning over the property took place on a Third Avenue car at the post office loop, because the law requires that a receiver's surrender of property shall take place on the premises. Adrian H. Larkin, of counsel for the Old Colony Trust Company, was with Mr. Vreeland and Mr. Grant when they got aboard the car. Mr. Grant said:

"In pursuance with the order of the court, granted on May 23, vacating the interlocutory order and discharging the receiver, and having received your affidavit that you have deposited the sum of $23,000,000 with the Morton Trust Company, I now formally resign the Third Avenue Railroad to you."

Mr. Vreeland replied: "I accept it, sir, and congratulate you on your work as receiver—the shortest receivership on record."

Two checks for over $17,000,000 each, drawn on the National Bank of Commerce and on the National City Bank, were paid by Messrs. Kuhn, Loeb & Company to the Morton Trust Company for the $35,000,000 bonds of the Third Avenue Company. It is believed that these are the largest amounts ever drawn by check in this city.

On Thursday night President Vreeland issued his first order to the officers and employees of the Third Avenue Railroad. In it he makes the announcement that the Metropolitan Street Railway Company will operate the newly acquired property as the Third Avenue division of the Metropolitan Street Railway system. The authority of the officers and the heads of department will be extended over this division, as follows: Orren Root, Jr., assistant to the president; F. D. Rounds, general superintendent; Henry A. Robinson, attorney; H. S. Beattie, treasurer; R. Warren, secretary; D. C. Moorhead, auditor; A. C. Tully, general purchasing agent; M. G. Starrett, chief engineer; Thomas Millen, general master mechanic; W. B. Reed, engineer of maintenance of way.

Mr. Rounds, the general superintendent, was general manager of the Third Avenue road under Mr. Grant. It was said that no changes had been made in the Third Avenue system, and that none would be made for two or three months. The heads of department are continued.

Sale of Seckner Company in St. Louis.

The Seckner Company, which secured the ten-year contract for lighting the down-town portion of St. Louis, has been sold to the Imperial Electric Light, Heat & Power Company. It is a step to merge all of the lighting and power companies of St. Louis into one corporation. The sale was completed May 18, but the actual transfer was only made May 22.

The Imperial Company bought the entire assets of the Seckner Company, the most valuable being the contract for city lighting, which carried with it a valuable franchise to enable the company to carry out the contract. The Imperial company also assumes all of the liabilities of the Seckner Company, including contracts with the Fort Wayne Electric Works for the necessary machinery and equipment. It is said that the Imperial Company will erect a plant and install this machinery on the property which adjoins its present location, instead of on the site purchased by the Seckner Company.

A one-fourth interest in the Seckner Company, it is said, was owned by Robert M. Shaw, agent for the Fort Wayne Electric Works, and this one-fourth interest was secured by James Campbell, who represents the controlling interest in the Laclede Gas Company. The other three-fourths' interest was secured by E. G. Bruckman, and the entire control of the company was transferred to the Imperial Company.

Preparations are being made at the Imperial Company's plant for putting in the new foundations for new boilers and new machinery as fast as they can be secured.

Representatives of J. G. White & Co., of New York, were in St. Louis lately examining the plants and equipments of the Laclede, Missouri-Edison Electric and Imperial companies as well as their franchises and financial standing.

Erie Telephone Meeting.

The annual meetings of the Erie Telegraph & Telephone Company and the companies comprising the Erie system will be held during June, as follows: Erie Telegraph & Telephone Company and Southwestern Telegraph & Telephone Company, in New York, June 12; Cleveland Telephone Company, at Cleveland, June 14; Wisconsin Telephone Company, at Milwaukee, June 18; Northwestern Telephone Exchange Company, at Minneapolis, June 19; Michigan Telephone Company, at Detroit, June 25.

The meetings, it is stated, will be attended by nearly all the new directors representing the purchasers of a controlling interest in the company. The new members of the board will be: John Jacob Astor, of New York; Charles E. Adams, of Lowell; George Crocker, of San Francisco; Frank A. Cutting, of Boston; Frederick A. Farrar, of Boston; H. E. Gawtry, of New York; W. H. Gelshennen, of New York; William J. Latta, of Philadelphia; Martin Maloney, of New York; Chas. W. Morse, of New York; Daniel O'Day, of New York; Frank Tilford, of New York; H. R. Wilson, of New York.

Marconi Patents.

Two patents were issued May 22 to Marconi on wireless telegraph apparatus. The specifications state that experience has shown that the aerial conductor sometimes becomes charged with atmospheric electricity, and when the same conductor is used both for transmitting and receiving, this electricity discharges through the operator when he shifts the conductor from the transmitter to the receiver, or through the coherer when the conductor is shifted from one instrument to the other—thus either giving a shock to the operator or injuring the coherer. To obviate this the aerial conductor is led in close proximity to one terminal of a sparking apparatus; and if a Rhumkorff coil or transformer is used, the aerial conductor can thus discharge itself by the small spark gap to earth through the secondary winding, thereby preventing the accumulation of atmospheric electricity in it. To this end the arm of the transmitting key is prolonged beyond its pivot, and carries an insulated terminal which is permanently connected to the aerial conductor. Below this terminal there is on the base of the instrument the terminal of the receiver. The arm is so arranged that immediately it is released by the operator after sending a message, it turns about on its pivot and thus connects the receiver to the aerial conductor.

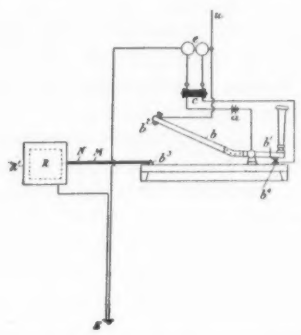


DIAGRAM OF MARCONI APPARATUS.

In the accompanying illustration *a* is a battery, *b* an ordinary Morse key closing the circuit through the primary of an induction coil *c*, the terminals of the secondary of which are connected to metallic balls, *e*; the aerial conductor, *u*, is led to, say, within one centimetre of one of the balls, the other being connected to earth at *E*. The key, *b*, has two contacts, b^1 and b^2, insulated from each other. The diagram shows the key in a position for sending, the contact b^1 touching the contact b^4 and closing the circuit of the battery, *a*, through the terminal of the induction coil, *c*. Immediately the key is released by the operator, the longer arm falls by its own weight, and the contact b^3 descends to the contact b^5, which is connected to the receiver, *R*, by the wire, *m*. It is found advantageous to insert an impedance coil between the terminal of the induction coil used for sending and the sphere which is connected to the aerial conductor. The wire connecting the receiver to the terminal on the base of the key should preferably be enclosed in a metal tube, *N*, to protect it from the oscillations of the local transmitter; and the tube *N* should be electrically connected to the box R^1.

CURRENT NEWS AND NOTES.

ALUMINUM TRANSMISSION WIRE.—The Snoqualmie Falls Power Company is stringing a heavier aluminum wire between Tacoma, Wash., and Snoqualmie Falls. The old wire gave some trouble from breaks, it is said. The new wire will be of a stronger alloy.

TROLLEY PAGEANT FLOATS.—A carnival will be held in Milwaukee during the latter part of June, one of the features of which will be electric pageant floats. These will run over the street car tracks. About 7000 decorative incandescent lamps will be fed from the trolley wires.

CANDLE TRUST IN MEXICO.—A trust has been formed in the City of Mexico of all the principal candle manufacturers in Mexico. The deal was promoted and consummated through a Syracuse firm which owns a large candle factory in the City of Mexico. It is evident that Mexico is a good field for electrical missionary work.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold its 49th annual meeting in New York June 23 to 30. Among the affiliated societies meeting with it may be mentioned the American Physical Society, American Chemical Society, American Mathematical Society, Astronomical and Physical Society of America and Society for the Promotion of Engineering Education. It is too early yet to announce the titles of the papers.

DISTRIBUTING NEWS BY TELEPHONE.—The New Telephone Company is engaged in perfecting arrangements for distributing news to the daily newspapers in the Central States. Ohio, Indiana and Illinois are the principal States that will be served by the company. It is proposed to form in each State a company that will gather news to be distributed to the newspapers by the telephone company. The daily newspapers in the smaller towns have found the system of great advantage.

UNIVERSITY OF MINNESOTA.—Among the interesting problems being taken up by the senior electricals are the following: Internal Illumination as Affected by Various Arrangements of Lights and by Different Colored Walls; Train Lighting; Pumping Action of Rotary Transformers; Automobile Controllers; Accuracy of Integrating Meters as Affected by Various Conditions such as Temperature, Frequency, Pressure, Current, etc.; Comparative Study of Direct Current and Alternating Current Arc Lamps.

TROLLEY CARS ON THE PROPOSED HUDSON RIVER BRIDGE.—The commissioners of the New York and New Jersey Bridge representing the State of New York a few days ago adopted revised double-deck plans for the proposed railway bridge over the Hudson River at New York. The new plans include the building of a second platform above the regular railway tracks for the exclusive use of trolley cars, and of an elevated structure for freight trains along the marginal docks along West Street, from Fifty-ninth Street to the Battery.

WASHINGTON TELEPHONE COMPANY.—The bill to incorporate the Washington (D. C.) Telephone Company will not be voted on by the Senate at this session. Though it has passed the House and been approved by the District Commissioners, its friends in the Senate have been unable to get the bill out of the hands of the committee having it in charge. It may pass next session, but this year it has practically been killed. Should it pass, it would jeopardize the interests of the Chesapeake & Potomac Telephone Company and practically put that company out of business.

INTERBOROUGH RAPID TRANSIT IN NEW YORK CITY.—The New York & Queens County Railroad Company has made an offer to the Rapid Transit Commission to build a tunnel from Borden Avenue, in Queens Borough, to connect with the main line of the Rapid Transit Subway in Manhattan, at Forty-second Street, for $2,750,000, and operate it when it is completed. The company now operates about 40 miles of surface street railway in Queens Borough, its lines extending from Long Island City through Flushing and Jamaica, to Far Rockaway.

BRUSSELS-ANTWERP ELECTRIC RAILWAY.—The Belgian Government has provided in its estimate before the Chamber for an electric railway between Brussels and Antwerp, which line is considered to be the forerunner of other similar ones. The cars will be run direct between Brussels and Antwerp without any intermediate stops. The rate of speed proposed is 62 miles per hour, which will permit trains to make the run between Brussels and Antwerp, a distance of 27 miles, in twenty-five minutes. The cost of construction is estimated at $7,720,000.

STRIKE OF STREET RAILWAY EMPLOYEES IN BERLIN.—On May 19 the employees of the Berlin tramways struck for higher wages. They, with the willing co-operation of their sympathizers, at once adopted American tactics to bring the employers to terms. A few non-unionists were engaged, but the strikers unhitched the horses from the cars with the result that all cars were withdrawn. There has been considerable rioting and the people apparently sympathize with the strikers, who number about 6000. The omnibusses were packed with people and cabs were at a premium. The strike was settled in a few days.

INDIANA MUTUAL TELEPHONE ASSOCIATION.—The fourth annual meeting of the Indiana Mutual Telephone Association was held at the Grand Hotel, Indianapolis, Ind., recently. Ninety-two representatives of the Independent telephone lines in the State were present. John McGregor, of Madison, presided and Harry B. Gates, of Indianapolis, was secretary. Reports indicate a rapid growth of the independent telephone movement in Indiana. Officers were elected as follows: President, John McGregor; vice-president, C. M. Zion, Lebanon; secretary, Harry Gates, Indianapolis; executive committee, L. A. Frazee, Hugh Dougherty, A. F. Ramsey and G. W. Beers. The association reports 160 independent exchanges and 40,000 and 7000 miles of toll wire in use in the State.

ELECTRIC WELDING.—An improvement in their well-known "water-pail" method of electric welding is described by Lagrange and Hoho in a patent dated May 22. This consists in a method for electrically heating two or more metals for welding, by connecting together the two metals with one electrical terminal, bringing them into contact with a liquid body, and then passing through the liquid and through the pieces of metal, current sufficient to develop at the points of contact with the liquid a gaseous resistance, which results in heating the metals to the welding point. Several forms of apparatus are shown. In one case the body of liquid is replaced by a jet of spray or steam issuing from a conducting pipe connected to one side of the circuit and striking at the junction of the two metals to be electrically welded, both of these being connected to the other side of the circuit.

ELECTRIC TRAMWAYS IN VALENCIA.—United States Consul Washington, at Valencia, Spain, reports that the business of the General Tramway Company of Valencia, embracing some 25 miles of rails, has been taken over by a French company, which is substituting electric power for the steam and horse traction hitherto employed. Electric cars are already running between Valencia and the port, a distance of three miles. The system employed is the overhead trolley. The cars are of Spanish construction, and the electric machinery and rails from Belgium. The Thomson-Houston Company is negotiating for the forty years' lease of some 12 miles of street rails belonging to another street car company. The Thomson-Houston Company also proposes to work these lines by electricity, and its offer is being favorably considered.

WEST TEXAS TELEPHONE ASSOCIATION.—At a meeting of the Independent Telephone of West Texas at Abilene, Tex., May 17, an association was organized, called the West Texas Telephone Association. The object of this association is the acquisition of experimental, statistical, scientific and practical knowledge of all matters relating to the construction, operation and maintenance of telephone exchanges, the advancement of their interests, and the establishment and maintenance of a spirit of fraternity between the members of the association by social intercourse and friendly exchange of information and ideas. The officers elected for the coming year were as follows: W. C. Roberts, Abilene, president; C. H. Woodward, Brownwood, vice-president; W. M. Brooke, Dallas, secretary; W. A. McSpadden, Cisco, treasurer. The next meeting will be held at Abilene, Aug. 8, 1900.

SENATOR DEPEW'S LONG-DISTANCE SPEECH.—Senator Depew, in Washington, delivered a speech to an audience in New York on the evening of May 23 over the Long-Distance Telephone. The occasion was the annual dinner of the Transportation Club, of which Senator Depew is president. When the Senator found that he would be unable to leave Washington to be present at the dinner, arrangements were made for a Long-Distance Telephone connection, the Senator having promised to give a speech over the wire from his Washington residence. The telephone company quickly connected sixty receivers, which were distributed around the tables, and at 9:30 Senator Depew delivered one of his characteristic speeches much to the delight of his distant auditors. Referring to the unique circumstances under which he was making his remarks, he said that it was the first time he ever made a speech 200 miles long. The points in the speech were vigorously applauded, and the Senator said, after the affair was over, that he heard the applause and laughter very distinctly. From an electrical standpoint the affair is reported to have been a great success.

CARBORUNDUM MANUFACTURES.—As usually manufactured, masses of carborundum have not been sufficiently solid to permit of their use in the arts without first separating the loosely held grains, cementing them together with clay or like bond, and firing the same. In two patents issued to F. A. J. Fitzgerald on May 22, a method is described to avoid this necessity, which consists in compressing a mass of corborundum and causing the same to recrystallize by heating to an intense degree. In practice, grains or powder of carborundum are mixed with a dilute solution of glue and then pressed into shape. The mass so molded is then heated in a furnace to or about the temperature originally used to produce the carborundum. When so treated, the carborundum will recrystallize and produce a very hard, dense mass. In this manner refractory bricks, crucibles and other carborundum articles may be produced in any forms desired.

TELEPHONE TAX IN SAN FRANCISCO.—The numerous attempts of the authorities of the city and county of San Francisco to extract some revenue from the telephone company culminated in the recent arrest of John I. Sabin, president and general manager, and Frederick W. Eaton, secretary of the Pacific and Sunset Telephone Companies. The officials of these allied companies were released on bonds to appear in the police court. The complaints are framed so as to enable the courts to make a test case, which is sought by the tax collector. They are based on three counts, all comprehended in the refusal of the corporation to pay its license on telephones in the city, or to tell the tax collector how many telephones are in use. One count applies to a 50-cent license tax levied upon each slot telephone. Another item of complaint is the refusal of the company to file with the collector a verified statement of the number of telephones in service. Each of these charges under the ordinance is a misdemeanor.

INCANDESCENT LAMP FILAMENTS.—Mr. S. B. Husselman, in a patent dated May 22, describes an incandescent lamp filament, which, it is claimed, is readily and cheaply manufactured, and practically indestructible. The filament consists of a thread of asbestos or similar material and an outer layer of a metallic fused compound of aluminum and iodine. The method of manufacturing such a filament comprises, first, heating aluminum and iodine in divided form, and alcohol, in suitable proportions, in an airtight retort, and to a temperature sufficient to reduce the mixture to a pasty semi-metallic mass. A thread of asbestos is then coated with this metal and permitted to dry. After being subjected thus to successive coatings, the thread, while still moist, is drawn between forming rolls or tubes to give it its required shape and density, after which it is heated in an airtight retort to a sufficiently high temperature to fuse the coating to the thread. When the filament is to be used it is cut into desired lengths and cemented in a glass bulb, which is then exhausted in the ordinary way.

THE OTTAWA FIRE.—One of the direct results arising out of the Ottawa fire may be of a somewhat revolutionary character. It is in regard to the rebuilding of the mills and factories on the old sites and the manner in which they will be supplied with power to operate them. The mill structures and factory buildings at the Chaudiere Falls, which were destroyed, were most expensive to construct, being built over the water. The development of electricity has obviated the necessity which existed when the mills were erected of locating them in close proximity to the water wheels which furnished the power. It is quite probable that the entire system of utilizing the magnificent water power available at the Chaudiere Falls may be applied to much better advantage than heretofore. A scheme is now on foot with the object of securing the amalgamation of most of the manufacturing interests at that point for the purpose of erecting a great power house where electrical energy can be generated and supplied to industries in the vicinity. The carbide establishments will use considerable of this electric power, and there will be sufficient to also provide energy, at a low enough figure, to secure the erection of new industries.

FUSED SALT PRIMARY BATTERY.—A patent was issued May 22 to W. S. Rawson, of London, England, on a primary battery of the class in which electricity is generated by the oxidizing action of a fused salt upon a molten metal or alloy separated from the salt by a porous pot or diaphragm, the oxidizing metal or alloy being continuously or intermittently re-fused by means of a carbonaceous gas or vapor and the salt recuperated by the action of oxygen or air forced into it. The cell is built of magnesia bricks free from silica and well lagged, and contains a porous pot, also of magnesia, which rests in a bath of molten lead having a temperature as high as 850 degs. F. A gas, such as coal or petroleum gas, is introduced under pressure into the molten lead. The porous pot contains the fused salt, as for example, a mixture of potassium bichromate, chromic sexquioxide and caustic potash, with or without lead oxide. The electrode within the porous cell is hollow and has horizontal branches extending along the bottom of the pot, these branches having perforated holes to sub-divide air or steam admitted under pressure. The e. m. f. of this battery is from 1 to 1.3 volts, according to the temperature. The output is stated to be about 40 watts per square foot of the immersed surface of the porous pot. During the working of the cell air or steam is blown through the molten salt and combustible gas through the lead. After passing through the cell, the resultant gas is used to raise steam for the operation of the cell.

SYNCHRONIZER FOR ALTERNATORS.—In order to recognize the synchronous or alternating-current machines which are to be switched into parallel, incandescent lamps have generally been employed, which are connected between corresponding terminals of the two machines. The extinguishment of the lamps furnishes an indication that the machines are in synchronism, while a continued flashing of the lamps shows that the machines are not in synchronism. In a patent dated May 22, issued to C. J. A. Michalke, of Charlottenburg, Germany, it is stated that this arrangement is objectionable, since it is impossible with it to tell whether the machine switched into circuit is running too fast or too slow, as in either case the fact of asynchronism is indicated by the alternate flashing and extinguishment of the lamps. This consequently renders the parallel switching considerably more difficult and dilatory, as it cannot be determined on which side the speed of rotation of the machine is to be regulated. To obviate this objection the following method is described. Suppose *A. B. C* and *a, b, c* represent the three corresponding terminals of two three-phase machines to be run in parallel. According to the former method, one lamp is connected between the terminals *A* and *a*, another between the terminals *B* and *b*, and a third between the terminals *C* and *c*. In the proposed method a lamp is connected between the terminals *A* and *a* as before; a second lamp is connected between the terminals *B* and *c*, and a third lamp between the terminals *C* and *b*. With this arrangement the lamps will not flash simultaneously during asynchronous operation, but will flash one after another. The succession or order in which the flashing of the lamps takes place will depend upon whether the machine to be switched into the circuit runs faster or slower. The direction of the flashing of the lamps being once determined, it may be easily ascertained thereafter whether any particular machine is running too fast or too slow. When the machines are running in synchronism, the lamp connected between *A* and *a* will be extinguished and the machines will then be switched in circuit together. At synchronism the other two lamps will be found to burn at about half of their normal brilliancy.

LETTERS TO THE EDITORS.

Practical vs. Theoretical.

To the Editors of Electrical World and Engineer:

Sirs:—I have been impressed more and more of late with the set-back given to the teaching of modern science by the indiscriminate use of the terms "theoretical" and "practical." I knew a professor in a certain school of science who seemed to delight in emphasizing to students the vast difference between the two results he was endeavoring to attain; and I really believe there grew, in the minds of the most susceptible, a notion of two distinct phases of science, one of which agreed with everyday life, the other being some remote, hypothetical study whose only value was a distant resemblance to fact in points at long intervals.

Some time ago this notion seemed to pervade the minds of some of our leading business men, who prized the unlearned but so-called practical machinist far more than the college graduate who was thought to be "full of nothing but book." We are all glad to see this prejudice fading away, and men coming to realize that the theoretical is but a study of the practical, and that if there is any apparent conflict it arises from an incorrect conception and not from any real lack of conformity in their attainments.

MARION, IND. DANIEL F. COMSTOCK.

Commutatorless Dynamos.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to Mr. Griene's letter in your issue of April 14, and to that of Mr. Percy in your issue of April 21, I beg to direct attention to the fact that the lines of magnetic force cannot be forced to revolve with pole-pieces of similar form. A dynamo like the one suggested would not generate current however the poles might be revolved. HUGO MÄKLIN.

HELSINGFORS, FINLAND.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

REFERENCES.

Weight Economy of Dynamos.—ROSENBERG.—An abstract of the German paper noticed in the Digest Apr. 7, May 5.—Lond. *Elec. Eng.*, May 11.

Continuous-Current Motors.—HOUEL.—The conclusion of his theoretical article noticed in the Digest May 19.—*L'Elec.*, Apr. 28.

LIGHTS AND LIGHTING.

Incandescent Street Lamps.—ADAMS.—An article in which he recommends a system of street lighting by incandescent lamps with a constant pressure distribution at either 500 or 1000 volts, four 16-cp lamps being grouped in series under a suitable reflector, and such groups being arranged every half block in business streets. The lamps should be of the long filament type, each for about 125 or 250 volts.—*Elec. Rev.*, May 16.

REFERENCES.

Three Arcs in Series.—RENARD.—A communication referring to the discussion in the Int. Soc. of Electricians in Paris (Digest, Feb. 3, Apr. 7), and describing some trials made by him. He is in favor of the arrangement of three arcs in series, especially where voltages of 115 to 120 are available.—*Bull. de la Soc. Int. des Elec.*, March.

Lighting of Cars.—A. Z.—A long, illustrated article on the Vicarino system, a brief description of which was abstracted in the Digest May 12. The compound-wound dynamo and automatic switches are described in detail.—*L'Ind. Elec.*, Apr. 25; briefly abstracted in Lond. *Elec. Eng.*, May 11.

Another illustrated description of this system, by Barbillion, in *L'Eclairage Elec.*, Apr. 7.

POWER.

Electric Power Transmission.—FORBES.—The first part of a paper read before the British Institution of Electrical Engineers. In this part he gives descriptions of the following transmission plants: At San Bernardino and Los Angeles in South California; the Snoqualmie Falls plant for transmitting power to Seattle and Tacoma; the Paderno development of the Adda River for supplying energy to Milan; the Rheinfelden plant; the Genoa continuous-current plant, and the plant of the Niagara Falls Power Co., all of which were already described in the ELEC. WORLD AND ENG. and in the Digest. The second part of the paper dealt with some of the problems that face the consulting engineer in his attempts to introduce the highest economy, especially in the transmission lines, as this is the most important part when the distances are great. He refers to Kelvin's law, and says it is true only when the electric power measured at each end of the line is approximately the same, that is, for a small drop in volts. By using boosters along the line the drop in volts can be corrected; he considers a transmission line of 40 miles, in which the ohmic loss in power and volts is 40 per cent, and divides it into four sections of 10 miles, with a loss of 10 per cent in each. Alongside of it a booster line may be placed: at the 10-mile station the volts are increased to the original amount by a booster at the expense of 10 per cent of current; in the second section of the booster line, there is only 90 per cent of the current, so that if the conductor has the same sectional area throughout, the second section may be 11 miles before losing the same as any other section of the non-booster or ordinary line. The third section will have a length of $1.1 \times 1.1 \times 10 = 12.1$ miles, the fourth 13.31 miles. Thus on the booster line the total loss of 40 per cent is reached only after traversing a distance of 46.41 instead of 40 miles without boosters and with the same sized wire. If instead of keeping the wire of constant section in the booster line, the length of sections would each be kept 10 miles, and the current density would be kept constant, the sectional area of the conductor in the four sections would be in the ratios of 1.0, 0.9, 0.81, 0.729, whose sum is 3.439, so that the weight of copper on the booster system would be reduced in the ratio 3.439 : 4, while the efficiency would be 65.61 per cent instead of 60 per cent without boosters. The loss in the boosters has been neglected in this example. In a long table he gives the weight of copper per horse-power and kilowatt delivered at the receiving end of a transmission line 100 miles long, with 10,000 volts at the generating end, without boosters; in three other tables he gives the results with boosters, when the line is divided into two, three and four sections respectively. Another way of working the booster system is to add to the distance already covered a new section of the same length as previous ones, with the current density calculated by Kelvin's law; he develops the relative formulas and gives two numerical tables. In a diagram he gives the copper required for each horse-power delivered at different inefficiencies. He concludes that by the booster method he is able to reduce the weight of copper (by putting in more turbines and dynamos) in some cases to less than one-half of what was possible by the old system; the chief advantage of using boosters is to save copper at the cost of power generated where the latter is cheap and the distance very great. He then takes the self-induction of the line into account, and gives in a table, the factors by which the ohmic drop of volts must be multiplied, in order to give the drop due to resistance and reactance, for different frequencies, and for different diameters and distances of wires, with single phase. Regarding the choice of polyphase systems, he says that two-phase, or three-phase star, or three-phase ring may be used. Three-phase star cannot well be used if any consumer's plant uses only one phase. Three-phase ring subjects the transformers to 1.7 times the electric pressure experienced by three-phase star, or two-phase, each earthed at the centre of the electric system. The principal advantage of the two-phase is that the two circuits may be electrically disconnected, either always or else during tests; this facilitates the detection of troubles and

gives far greater security. He makes some remarks on overhead and underground conductors and on aluminum conductors. He concludes with the following suggestions: The arrangement which suits a transmission line which is also a distributor of power, does not necessarily yield the best results for a plant transmitting the whole power to a long distance. The high-pressure continuous-current system is very suitable for certain cases, as worked out at Genoa. The two-phase alternating-current is to be preferred over the three-phase in many cases, and especially where an earth return can be used. The horizontal shaft for turbine and dynamo which is so much in vogue, might well be replaced by a vertical shaft, as at Niagara, Rheinfelden and other places.—Lond. *Elec., Elec. Eng.,* May 4, 11; the first part also in Lond. *Elec. Rev.,* May 11.

Electricity in Cotton Mills.—PAINE.—A long abstract of a paper read before the Southern Cotton Spinners' Association, on the development of electric driving of cotton mills. The electric system does not increase the original investment by the amount of money paid for the electrical equipment; in many items the first cost is greatly reduced; no belt or rope tower is required, the large main drive is omitted; extensions are very simple. Sub-divisions into independent sections, each driven by its own motor, avoids the speed variations in one section due to slipping on such belting as is still retained, and the variations are not communicated to other sections. If a shut-down occurs, it is only partial and local. In the operation of one or more sections, overtime is possible without driving the shafting in any other sections. There is less difficulty in keeping the shafting aligned. Steadiness and uniformity of speed is occasioned by omission of many pulleys and belts, and results in greatly increased production. It also necessitates fewer repairs on the machinery, especially the looms. On large plants the loss between the prime mover and the shafting driven by the motors varies from 16 to 18 per cent, while with the mechanical system the losses are difficult to be determined. Improved light and ventilation are obtained by removing the power house away from the mill and by the omission of the belt tower. The power to operate any sections may be readily measured by special indicators in the engine room, which enable the engineer in charge to detect at a glance any unnecessary consumption of power due to poor alignment of shafting, improper oiling, etc.; such indicators are in use in the Olympia Mills, at Columbia, S. C., and in the Lancaster Mills, at Lancaster, Mass. The generating plant may be sub-divided into two or more units, which insures against a complete shut-down and allows one or more sections of the mill to be operated from either generator.—*Eng. News,* May 17.

Electricity in Mines.—BENTHAM.—The first part of an illustrated paper, read before the Manchester Society of Junior Electrical Engineers. He supposes the use of the continuous-current system and discusses in the first part the advantages and disadvantages of steam and electricity as motive power for mining purposes. He then describes the plant required. For a colliery having an output of 2000 tons per day, when working two shifts per day, the power required on the surface is given as follows: 100 horse-power for driving the screening and coal-dressing plant which is split into several units, 200 horse-power for driving the coal-washing plant, consisting of several units; 100 horse-power for driving fan direct-coupled, 25 horse-power to drive joiners' shop, including circular saw, band saw, planing machine, etc.; 25 horse-power for driving fitting shop, 50 horse-power for driving feed pumps, 50 horse-power for draining the mine, giving in all 550 horse-power for driving the requisite surface plant. The power required for underground haulage purposes, is equal to 400 horse-power divided into three units, one of 200 horse-power and two of 100 horse-power each; he would also allow 50 horse-power for electrical coal cutting, making a total of 450 horse-power for underground use, or a grand total of 1000 horse-power for all power purposes. He would install one engine of 600 horse-power, one of 300 horse-power and one of 200 horse-power of the slow-speed direct-coupled type; the continuous-current generators should be multipolar machines very strongly built, with toothed armatures and carbon brushes, which should not require shifting from no load to full load; they should give 600 volts at the terminals, which voltage may be varied within certain limits by regulating the speed of the engine. He then discusses the switchboard, the mains and the methods used for fixing cables in the pit shaft.—Lond. *Elec. Eng.,* May 11.

REFERENCES.

Boilers and Engines.—A full reprint of the regulations for efficiency tests of boilers and engines, which have been accepted by the Society of German Engineers and by the Society of German Machine Manufacturers. The International Union of Societies for Boiler Controlling has still to vote on them.—*Elek. Zeit.,* May 3.

Electricity for Agricultural Purposes.—RENAUD.—The first part of a long paper, read before the Eastern Industrial Society of France, in which, after a brief historical introduction, he gives illustrated descriptions of quite a number of different types of ploughs and other agricultural apparatus, driven by electric power.—*L'Elec.,* Apr. 28, May 5.

TRACTION.

Automobiles.—KUMMER.—A theoretical paper, the first part of which treats of the general problem of automobiles. He develops three general equations which hold good not only for the so-called automobiles running on ordinary roads, but also for the locomotives of any traction system, except for those electric locomotives or motor cars which are supplied continually with power from the outside by means of sliding contacts. The apparatus containing the energy available for traction, whether electrical or otherwise, is called by him the accumulator of the automobile. His three equations represent the general relations between the constants of the accumulator, those of the automobile and those of the road. The first equation signifies that the product of the total weight of the automobile, including passengers, and of the length of road in kilometres, made by the automobile during a whole discharge of the accumulator at normal rate, is equal to 0.367 times the weight of the accumulator in kilograms, multiplied with the capacity of the accumulator in watt-hours per kilogram, multiplied with the efficiency of the automobile (i. e., the ratio of the energy at the wheel circumference of the automobile and the energy at the terminals of the accumulator), divided by the sum of the traction coefficients of the road and the tangents of the angle of the grade of the road. The equation is developed under the supposition that the latter sum, the speed of the automobile and the power of the accumulator, are constant, and is sufficient for the calculation and testing of automobiles running on ordinary roads. If the quantities on the right side of this equation are given constants, the equation gives the relation between the total weight of the automobile and the length of line over which it runs at a total discharge of the accumulator, and shows that this weight may be represented as a function of this length of line by an equilateral hyperbola, showing how many kilometres any weight of automobile may be forwarded with a given accumulator and a given road. The speed at which this is accomplished, is given by his second equation; it is equal in kilometres per hour to the length of line over which it runs with a total discharge of the accumulator, multiplied with the ratio of the rate of the accumulator in watt per kilogram and the capacity of the accumulator in watt-hours per kilogram. The third equation signifies in general that the latter capacity is a given function of the former rate. These three equations represent the general solution of the following two main questions: how to determine the accumulator necessary to forward a given automobile on a given road with a given load and at a given speed, and how to determine the automobile which is driven by a given accumulator on a given road at a given speed.—In the second part of his article he deals with electric automobiles. The third of his general equations has here the following form: the capacity in watt-hours per kilogram, multiplied with the n'th power of the rate in watts per kilogram, is constant, where n is a constant between one-third and two-thirds. This equation represents the well-known fact that the energy given out by an accumulator is the less, the higher the rate of discharges in amperes. He gives this relation for a given accumulator in the form of a diagram, and applies his equations to a numerical example. So far he has assumed that the sum of the traction coefficient of the road and of the tangents of the angle of grade of the road, is constant. He remarks that this supposition is sufficient for the calculation and testing of automobiles running on ordinary roads without rails; as such automobiles have to run on a road with any grade and with any coefficient of traction, it would not be worth while to calculate the automobile for another road than with a constant value of this sum; and only for roads with a constant value of this sum, different types of automobiles may be compared. He then shows how to calculate an automobile which has to run on rails; it has always to run over the same line of given properties, and the automobile with its accumulator are to be calculated so that the stations where the accumulator is exchanged have the most convenient location. His method of calculation is simple, but too analytical to be abstracted here.—*Elek. Zeit.,* May 3.

Systems of Electric Traction.—An editorial referring to several lines, on which three-phase current is used for transmission, and continuous current for operating the motors on the cars; while in Continental Europe motor-generators are preferred, large plants in the United States are installed with synchronous converters. Where the distances are not excessive, high-pressure transmission by continous currents is feasible, as on the City & South London Road. The direct application of the three-phase supply to the motors on the cars has been a remarkable success on some lines in Continental Europe; the constancy of speed of the cars, the simplicity of the transforming apparatus, and the total absence of electrolytic troubles, are arguments in its favor, while its disadvantages are that the drop in the rails is increased by the inductance, the double trolley is unsightly, the magnetic blow-out controller is inapplicable, and the induction motor does not lend itself to series-parallel control. The conduit, the surface contact and the accumulator systems appear to be at a standstill. A series of electric launches on the Thames is recommended, as accumulator traction is at its best when applied to the propulsion of boats, and is entirely free from the nuisances of smoke, heat and vibration.—Lond. *Elec. Rev.*, May 11.

High Speed on Electric Railways.—Gerson.—A long abstract of a paper, read before a street railway association in Vienna, in which he shows the necessary limits of speed for steam railroads, and discusses the different systems of electric traction for trunk lines. The trials with Heilmann's locomotive are said to have proved unsatisfactory. The accumulator system appears to be very promising, but has yet many faults and does not fulfil with certainty the requirements as to cost and efficiency. The third system, which has been tried, is the ordinary method of supplying current from a central station to electromotors on the cars. The project of Zipernowsky in 1891 of connecting Budapest with Vienna is referred to; also the line in operation since 1895 from Nantasket to the Beach, of the New York, New Haven & Hartford road; also the line now under construction between Liverpool and Manchester. Recently in Berlin, under the auspices of the most prominent industrial and banking firms and of governmental and military officials, a "Studying Society" or company for electric trunk roads has been founded, which will spend its whole capital of $375,000 for the theoretical and practical study of the question, and is about to build a trial line of nine miles, without the purpose of making money. One of the respective problems, the installation of terminal stations for electric trunk roads with a speed of 120 miles per hour, has been taken up by offering a prize.—*Elek. Zeit.*, May 3.

High Speeds in Electric Traction.—Wetmore.—An article referred to in the recent contract which was let for the equipment of an electric trolley line between Detroit and Toledo, capable of maintaining a speed of sixty miles per hour. It is shown that a very taut trolley wire and strong taut spans and the best of accurate overhead construction are required there. He thinks that high electric railway speeds are better secured with the third-rail system. Improved contact devices are, however, required. He believes a very desirable device would be a rolling contact with a multiplicity of contact surfaces.—*El'ty*, May 16.

Railway Unit.—An illustrated description of a new unit for the Toledo Traction Co., consisting of a vertical cross-compound engine direct connected to a 1050-kw generator which since its installation last November has carried nearly the whole of the railway load which varies from 1500 to 3500 amperes, being supplemented when necessary by one or more 400-kw generators with which it works in parallel. At the rated speed of 80 r. p. m. it gives 500 volts with no load, and over-compounds to 575 volts with a load of 1820 amperes, which load is carried continuously without undue rise of temperature. The machine is described in detail.—*St. R'y Rev.*, May 15.

REFERENCES.

Rules and Regulations.—A reprint of the safety regulations for electric traction installations, which shall apply to electric railways with the trolley system, and to those with accumulators in the cars, so far as they are operated at a voltage between 250 and 1000. The regulations will be voted on at the next session of the Union of German Electrical Engineers.—*Elek. Zeit.*, May 10.

Mixed System.—Gosselin.—A well-illustrated paper, read before the Int. Society of Electricians in Paris, in which he describes an electric line in the Bois de Boulogne in Paris, where a mixed trolley and surface contact system is used, devised by Vedovelli. The line is divided into nine parts, provided alternately with the trolley and with the surface contact system, the latter on those parts where the trolley system was not allowed by the government on account of its alleged unsightliness.—*Bull. de la Soc. Int. des Elec.*, March.

Shunting Locomotives.—Perkins.—An illustrated description of two English types of electric "shunting locomotives" for switching freight cars.—*El'ty*, May 16.

Denver.—Durbin.—An illustrated article on the installation of the trolley system on the Denver tramways, replacing the old cable system.—*St. R'y Rev.*, May 15.

Palermo.—An illustrated article on the line described in the Digest May 5.—*St. R'y Rev.*, May 15.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Dortmund.—Dick.—A continuation of the illustrated article noticed in the Digest May 26. The continuous-current distribution is arranged on the three-wire system with 220 volts between the outers. All the feeders are connected to the bus-bars in the sub-station which are supplied directly from the cells. The outer wires of the network are steel-armored, lead-covered single cables, while the middle wire is of bare tinned copper. The feeders have no middle wire, as with such a closely-connected network and an earthed neutral distributor, it is superfluous. The distribution for the external area on the three-phase system is effected entirely at the pressure of 3×2600 volts without special feeders. Single transformers are installed on consumer's premises, reducing the pressure to 3×120 volts. The cables are three-core, lead-covered, steel-armored, and are laid directly into the ground. The industrial conditions of Dortmund render a combined system of distribution with continuous and three-phase currents highly suitable. In the older central portion of the town, the motor output is about three-fourths that of the lighting, and where power is required the maximum individual demand is not excessive, so that continuous current is very suitable there. In the outer zone where the factories are situated, the demand for motive power is 22 times as much as that for lighting, and larger motors are to be supplied. Three-phase distribution is used there; where there is an exceptionally large power consumer in the central area, a special service is laid from the three-phase system instead of connecting the consumer to the central current network. In any house, bare wires may be used for the neutral, but these must be of tinned copper and not less than one-sixteenth inch in diameter, and wherever possible must be connected to earth. The two allowable methods of installing wires are to attach them to insulators, or to run them in iron pipes; wood casing is absolutely forbidden. Each consumer having more than one kilowatt in lamps installed, must divide his lamps into two equal groups and connect them to opposite sides of the three-wire system.—Lond. *Elec.*, May 11.

Switzerland.—An abstract of the report of the Swiss telegraph office on new electric light and power installations, which this office has to control. One hundred and forty-three projects were presented in 1899, of which 70 were for new installations, 63 for extensions, and 10 for alterations. Of the new installations, 28 were lighting plants, of which 26 use continuous current and 2 alternating current; 20 plants for power transmission, 9 being operated by continuous current, 9 by three-phase current, 2 by single-phase alternating current; 22 plants for power transmission and lighting, 3 being operated with continuous current, 16 with three-phase current, 2 with quarter-phase and 1 with single-phase alternating current. The total power of the new installations is 19,181 kilowatts. Unexpectedly great was the number of disturbances in the telephone lines by the power transmission and railway circuits.—*Elek. Zeit.*, May 3.

REFERENCES.

Electricity in Buildings.—Hill.—A well-illustrated paper read before the Amer. Inst. of Architects. He gives an outline of the different parts of a complete electric plant, for which suitable space and foundation must be provided in a modern building; the power plant with generator, storage battery and switchboard, the cables and wiring, the electric lamps, the ventilators, elevators, motors for power purposes, electric working utensils, electric irons, kettles, ovens, etc. He briefly discusses the efficiency and regulation of electric plants, the loading of the plant and the selection of the units, and describes some typical installations, as the Park Row Building, of New York; the United States Capitol Building, of Washington; the Board of Trade Building, of Chicago; G. J. Gould's residence, the Kirkwood Inn, and the Westinghouse factories.—*Proc. of the Amer. Inst. of Archit.*, 1900.

Switch Gear.—An illustrated description of a simple high-tension sub-station equipment, giving diagrams of the connection of a sub-station gear for one feeder and three transformers, and of another for two feeders and eight transformers.—Lond. *Elec. Rev.,* May 11.

Accessories for 220-Volt Circuits.—ZETTER.—A brief, illustrated paper, read before the Int. Society of Electricians in Paris, in which he describes circuit breakers and other apparatus for 220-volt circuits.—*Bull. de la Soc. Int. des Elec.,* March.

Copenhagen.—HOEST.—A detailed, well-illustrated description of the municipal electric plant of Vesterbro, which is the suburban part of the city of Copenhagen. The three-wire system at 2 × 110 volts, with an accumulator battery, is used.—*Elek. Zeit.,* May 10.

Tricst.—SZUK.—An illustrated French abstract of the German article noticed in the Digest Mar. 3.—*L'Eclairage Elec.,* Mar. 31.

Boston.—An illustrated description of the large new plant of the Boston Electric Light Company, which supplies continuous current for series arc lighting and alternating current for incandescent lighting and power purposes.—*Elec. Rev.,* May 16.

WIRES, WIRING AND CONDUITS.

Electric Wiring of Buildings.—A long abstract of the very extended discussion which followed the paper of Chamen, abstracted in the Digest Feb. 24. Bathurst said an internally insulated pipe was the only form of electric piping to adopt, a wire inside forming the positive and the armoring of the pipe the negative or return conductor; by the general adoption of a correct principle of earthing, the cost of wiring could be reduced and the work done well and satisfactorily from the first. Mavor criticized the British Board of Trade regulations; he thought Bathurst's arguments in favor of the use of metallic tube systems were worthy of respect, but preferred to maintain his own views as to putting the insulation upon the positive conductor, instead of placing it on the inside of the negative conductor; with double wiring, when each conductor had to be covered with expensive insulating material, the cost was unnecessarily great. Denny had found lead-covered wires satisfactory in shipwork, and preferred single wiring to double; the fewer the wires, the less the risk, and with double wiring there was a chance of either wire going to earth without one's knowing it at once; he objected to iron pipes, as he found them to be water traps and not so flexible under the particular conditions as lead-covered wires. Sayers disagreed with Chamen on the question of bunching; he thought it to be to some extent desirable for practical reasons, for the larger the cable the greater the amount of power present for destructive purposes, while the change of damage occurring to a group of bunched wires was remote; some limit should be assigned to bunching; he pointed out to Bathurst that a system of the kind he had described with a bare conductor might rapidly go wrong if water got into it as the salt of copper or iron might attack both conductor and insulation, and he asked how this system could be made watertight. Tidd said that what was good enough for ship work should be good enough for land work; while on ship work, with its comparatively short runs and densely clustered lamp points, the entire absence of joints of any kind in the wiring was advisable and a possible condition, it cannot be so readily attained in land installations; wood casing should be abolished, except when used simply as covering for ornamental purposes; he agreed with Chamen in his condemnation of the use of thin iron skelps; much as he objected to wood casing, he would, however, sooner risk an electrical fire with that system than a gas fire caused electrically by a badly earthed metal sheathing system; in regard to lead sheathing of wires, he thought that a nail driven through it would usually cause a direct short circuit, and this he considered a point in favor of this system in comparison with wood casing, as it was better to have a dead short circuit and blow the fuse immediately, rather than have a high resistance fault which might be neglected until damage was done; the main point in lead-covered wire was to make the lead sheathing watertight by using throughout metal cases in connection with the various joints and fittings, and sweating the wires into them, making this a necessity with the workman; the insulation of the wire itself should also be carried into the case in a mechanical manner, so that the workman need not trouble himself with wrapping the joint with tape, solution, etc.; the provision of specially prepared pieces of insulating material fitting the metal cases, eliminated to a large extent the danger of careless or incompetent workmen. Clark thought at present there were only two systems which demanded serious consideration: first, that of iron tubes, insulated or not internally, the various lengths being screwed into special junction boxes; second, the lead-covered twin-wire system with special joint boxes; the objections to the first were internal condensation or sweating, possible damage to cables when drawing in, and imperfect continuity of the metal sheathing; the only objection against lead-covered wires was their liability to injury from nails, which he thought was grossly exaggerated; he thought the metallic continuity of lead-covered systems could be obtained by soldering the joints throughout, and the cables were not liable to injury as in the case of wires drawn into the tubes; there was no internal condensation, and old buildings could be wired with a minimum of cutting away, and in many cases with none. Bathurst replied to Sayers that it was not more difficult to provide an air and watertight electric pipe system, when properly designed material was used and screwed joints were made, than it was to install an iron pipe system; his experience with a bare copper wire inside steel-armored insulating conduits showed that if water collected inside the pipe, the first tendency of any current leaking between the inner and outer conductors was to dry out the moisture, but failing this, the final result was a short circuit, which immediately blew the circuit fuse; the insulating lining adopted was resilient, and it was found that after the end of the conduit had apparently been trimmed square with the tools provided, the lining still tended to protrude, so that if two pipes were screwed up end to end into a socket, there was a tendency to form an inside seal in addition to the protection afforded by the iron socket from the outside; he maintained that insulation applied in a "tube" form would be found to have many practical advantages; for instance, in the case of fuses being changed, the loose inner copper conductor could be burnt out without destroying the surrounding insulation, while any slight heating trouble arising from overloading would be indicated by smoke or smell without necessarily serious damage. Dewar thought mechanical protection for the wires was a very important point, but his experience was that the interior of a tube was a more important matter than the exterior, and he had never found ordinary iron piping absolutely free from defects inside. Chamen defended the Board of Trade by stating that they received so many recommendations that the main result was bewilderment. He questioned the bunching suggestions of Sayers, and thought the idea of using many small wires in one group led to the impression that they could be treated like so many bell or telephone wires. The great objection to wood casing was that any place might become damp at some time or another. He thought the corrosion of the lead sheathing of house wires should not be attributed solely to the action of the plaster, but that it became electrically charged from end connections, and that the current traversing it caused electrolytic action. In Glasgow he had taken a new departure in respect to three-wire continuous-current supply by using three-wire concentric cable, arranging the earthed or neutral conductors outside the others, and next to the lead sheathing, so that the sheathing being at the same potential as the earth, no electrolytic action was possible. The end connections still had to be looked after. He has seen an installation carried out with the Simplex tube system, and was astonished to find how well it could be done.—Lond. *Elec. Rev.,* May 4.

House Wiring.—WALKER.—The conclusion of the article noticed in the Digest May 26. He speaks well of vulcanized rubber covered wires drawn into lead tubes, the whole laid in channels in the plaster. The twin form of the paper or fibre insulated wires, overlaid with lead tubes and run in channels in the plaster, is probably the neatest, quickest and cheapest form of wiring for the inside of buildings: the one objection is the possibility of a puncture or a crack in the lead tube, causing the early breakdown of the insulation. Vulcanized rubber covered wires, or any of the paper or fibre covered wires, run inside glass lined tubes, the rubber covered wire not being drawn into lead tubes, appears to be a very efficient arrangement, both electrically and mechanically, but it has the great objection that the glass lined piping adds very considerably to the cost of wiring, without increasing the safety; he questions the one great feature which it is alleged to possess, namely, freedom from the possibility of transmitting heat to surrounding objects.—Lond. *Elec. Rev.,* May 11.

Matthiessen's Standard Copper Constants.—CAMPBELL.—A communication referring to the letter of Everett (Digest, May 26), and pointing out that, if a new value of an arbitrary standard is to be adopted, it should be simple, clear, universal and easily remembered. He shows that the standard proposed by the Committee on Copper Conductors (Digest, Jan. 13) fulfils none of these conditions. He has used for some years as the value of the copper standard 0.1500 international ohm at 15° C. for 1 metre 1 gram, which fulfils the above

conditions and agrees closely with the value given by Matthiessen for soft copper.—Lond. *Elec.*, May 11.

REFERENCES.

Inductance of Long Transmission Lines.—SARTORI.—A mathematical article, illustrated by diagrams, in which he calculates formulas for the coefficients of self-induction and mutual induction for three-phase transmission lines, and applies these formulas to a practical numerical example.—*Elek. Neu. Anz.*, May 1.

Cables.—ROUSSEAU.—An illustrated description of electric cables devised by de la Mathe, to be used for trailing purposes which therefore must be very flexible and strong so that the electric communication is not interrupted by external mechanical action.—*L'Elec.*, Apr. 21.

ELECTRO-PHYSICS AND MAGNETISM.

Arcs Between Metals.—ARONS.—An account of a very long series of experiments in which he studied the electric arc as influenced by the surrounding gas. Metallic electrodes are for this purpose much to be preferred to carbon electrodes, as their composition is better defined and they do not give out such great quantities of gases. Measurements were made with nitrogen and hydrogen; in the former, arcs were obtained between aluminum, cadmium, copper, iron, magnesium, platinum and brass electrodes; tin melted at once; between silver electrodes no arc could be made, while silver yields a particularly brilliant arc in air. In hydrogen, copper and aluminum give no arcs, while they give very beautiful arcs in nitrogen; the best hydrogen arcs are obtained with cadmium, zinc and magnesium.—*Ann. der Physik*, No. 4; abstracted in Lond. *Elec.*, May 11.

Maximum Sensitiveness of Coherers.—BLONDEL and DOBKEVITCH.—A French Academy note showing that the effect produced by Tissot, who immersed a coherer in a magnetic field (Digest, May 26) is simply due to the increased cohesion of the particles, and is therefore purely mechanical. The same increase of sensitiveness may be obtained by increasing the amount of filings between the electrodes, and thus increasing the mutual pressure of the particles. The best conditions for maximum sensitiveness of the coherer are given.—*Comptes Rendus*, Apr. 23; *L'Elec.*, May 12; abstracted in Lond. *Elec.*, May 11.

Coherer.—LAMOTTE.—A long article, in which he reaches the following conclusions: The variation of the contact resistance under the influence of electric waves is a rather frequent phenomenon which is produced in all cases where the contact surfaces are apt to be modified by the passage of sparks; at least in all experiments where this condition was fulfilled a variation of resistance was observed. The experiments of Arons, Blondel, Tommasina and others confirm the theory of Lodge; there is, however, a certain difficulty to be surmounted in order to generalize this theory; it is necessary to take up again the explanation of the phenomena observed by Branly, with mixtures of conductive powders and solid dielectrics, where the hardness of the material does not allow any displacement, or any immediate contact of the particles. The large number of experiments with the coherer is due less to scientific interest than to the essential part which this apparatus plays in wireless telegraphy.—*L'Eclairage Elec.*, Mar. 31.

REFERENCES.

Paris Exposition.—An illustrated description of the three-phase alternator of 2000 kilowatts of Siemens & Halske, exhibited there.—*Elek. Zeit.*, May 3.

An editorial summary of the German electrical exhibits.—*Elek. Zeit.*, May 3.

An illustrated description of the three-phase and continuous-current generators of Lahmeyer & Co., exhibited there.—*Elek. Zeit.*, May 10.

E. K. SCOTT.—An illustrated article, giving brief notes on the electrical exhibits of Germany, Great Britain, Hungary, France, Switzerland, Belgium, Italy, United States.—Lond. *Elec. Rev.*, May 11.

NELSON-UHRY.—A well-illustrated article on the inclined moving platform system of Cance & Sons.—*L'Eclairage Elec.*, May 12.

E. H.—An article criticizing the architecture of the electricity palaces.—*L'Ind. Elec.*, May 10.

Other articles on the Exposition, giving preliminary notes and partly illustrated, in *La Nature*, Mar. 3, 10, 17, 24, 31, Apr. 7; *L'Elec.*, Mar. 17, Apr. 21, 28; *L'Eclairage Elec.*, Feb. 24, Apr. 21, 28, May 5.

Lightning Flash.—MEIDINGER.—An illustrated article on a lightning flash which set an alcohol plant near Carlruhe, Germany, on fire. It struck the lightning rod, but did not follow it; the discharge extended along all metallic bodies which it found on its way. There was an air-gap on its way where a spark sprang over and caused the explosion of a mixture of alcoholic vapor and air.—*Elek. Zeit.*, May 3.

Metallurgy of Iron.—BELLOC.—A long, illustrated historical outline of the applications of electricity and magnetism to the metallurgy of iron, describing quite a number of processes and apparatus.—*L'Elettricista*, January; abstracted at some length, with illustrations, in *L'Eclairage Elec.*, Mar. 24.

Gasoline Motors.—BERTHIER.—A note on the different methods of electric ignition in gasoline motors.—*L'Eclairage Elec.*, Mar. 24.

Interrupter.—ROCHEFORT.—An illustrated description of a new automatic interrupter for the ignition in gas motors.—*La Nature*, Apr. 21.

Electrical Engineers in the War.—An illustrated reprint of the English articles noticed in the Digest May 19.—*El'ty*, May 16.

London.—The first part of an illustrated article on the scheme for "the telephoning of London" by the government. The post-office is about to commence laying the underground mains. Particulars are given about the area to be served and the exchanges to be established, the cables to be used and the conduits to be constructed.—Lond. *Elec. Rev.*, May 11.

Cables.—QUEINNEC.—An article on the use of a mixture of Swedish pitch and tallow for the junctions of telephonic and telegraphic cables.—*Ann. Telegr*, v. 25, p. 385; abstracted in *L'Eclairage Elec.*, Mar. 31.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Testing the Magnetic Properties of Sheet Iron.—NIETHAMMER.—A brief communication referring to the article of Epstein, abstracted in the Digest May 19. For exact measurements the tested sample should have rounded corners; ring-formed samples may be the best; the length of magnetic lines of force is smaller on the inside than on the outside of the ring, so that the induction is not uniform over the cross-section. The values found by Epstein's method apply to transformers only, not to the armatures of dynamos, as the loss of hysteresis, produced by the rotation of iron in a constant magnetic field, differs from the loss of hysteresis produced in a fixed iron by an alternating magnetic field. He questions the agreement found by Epstein between alternating-current hysteresis and magnetostatic hysteresis, as other authors found the latter to be somewhat smaller than the former.—*Elek. Zeit.*, May 3.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Party-Line System.—BLUT.—An illustrated paper, read before the Electrotechnical Society of Berlin, describing a system which he has devised, and which in some respects might be called a party-line system. It involves the use of a main telephone which is connected with the station and which costs about $45 per year. With this are connected various other parties, who may supply their own telephones, paying to the central station $2.50 to $3.75 for the right to connect with that main telephone. Each party can call up the central station directly if the signal shows that the line is free; during a conversation no other party can listen nor in any way disturb the conversation or call up the central. If one of the parties is called by the central station the main telephone is called up first, and from there the signal is given to the party desired by pressing a button and turning a lever.—*Elek. Zeit.*, Apr. 19.

REFERENCES.

Energy of Cathode Rays.—CADY.—An account of a determination of this energy. A complication is introduced when the measurements are made with the thermo element or the bolometer by the fact that a portion of the cathode rays is reflected. He endeavors to determine the proportion of the reflected rays and also the extent, if any, to which they lose their energy in the process of reflection.—*Ann. der Phys.*, No. 4.; abstracted in Lond. *Elec.*, May 11.

Hertzian Waves.—SWYNGEDAUW.—An account of an experimental study of the Hertz discharger.—*Comptes Rendus*, vol. 130, p. 708; *L'Eclairage Elec.*, Mar. 24.

Magnetic Induction.—STEFANINI.—An account of an experimental investigation of the distribution of the magnetic induction, produced by an induction coil with iron core.—*Il Nuovo Cim.*, June; abstracted in *L'Eclairage Elec.*, Mar. 24.

ELECTRO-CHEMISTRY AND BATTERIES.

Local Discharges in the Lead Accumulator.—SCHOOP.—An article in which he discusses the different reasons of such "silent" discharges, which are often very obnoxious. They may be due to impurities of the active material or of the cores of the electrodes; small additions

of palladium and platinum cause local discharges; additions of copper, arsenic, iron, etc., act in a similar way, as do also impurities of the electrolytes, especially the presence of materials of the sulphide of hydrogen group. He then shows that even if all materials used are of ideal impurity, local discharges must occur, as they are intrinsically connected with the nature of the processes occurring in the accumulator; they are due to potential differences in and at the electrodes, which arise even with pure materials. He found a potential difference of 0.225-volt between charged spongy lead and a core of hard lead containing 12 per cent of antimony, and a potential difference of 0.055-volt between charged spongy lead and a core of soft lead; after 30 minutes the voltmeter gave 0.16 and 0.1-volt respectively. He found that accumulators with a hard lead grid, develop about double the quantity of gas developed by accumulators with a soft lead grid. About a quarter of an hour after the interruption of the charging current, a charged negative plate of good quality should show no development of gas either at rest or if discharged; at the positive plate, however, generally considerable quantities of oxygen are developed, and that during the whole discharge; probably this is the case with all systems. He thinks that the manufacturer may not be inclined to give up the use of hard lead for accumulators, especially where a certain stability of the plates is required, as for automobiles; nevertheless, he recommends using lead containing antimony, but as little as possible, especially for stationary batteries. It appears also why it is of importance whether a capacity test of an accumulator is made immediately after the charging has been done, or after a longer time of rest. Finally he discusses several influences which may cause or increase local discharges; such as the additions of graphite or collodium to the active material; the presence of impurities, especially of chlorine, due to the Planté formation; repeated mechanical shocks and shaking during the discharge, as in automobiles, the decomposition of insulating material, especially celluloid, which is substantially altered by ozone; a bad distribution of current over the surface of an electrode, so that one-half of the plate charges up the other plate, to which process the phenomenon of "recovering" is partially due, which requires consumption of energy; the exposition of the accumulators to direct sunlight, by which peroxide of lead is decomposed.—*Elek. Neu. Anz.*, May 1.

Electrodeposition of Copper.—BAWTREE.—A paper read before the Finsbury Technical College, giving some practical points on the electrodeposition of copper. The nature of a solid deposit is crystalline, and the deposit is therefore finer, the quicker the crystals are thrown down; the slower the deposition and consequently the larger the crystals, the softer and tougher will be the deposit. Whatever be the shape of the work, the deposit always tends to go to the edges. Almost any solution of copper salts gives a good deposited plate, provided the conducting surface and current density are correct. A sulphate solution need contain nothing but sulphate of copper and sulphuric acid. The most reliable bath is a nearly saturated solution of sulphate of copper, containing 5 per cent by volume of sulphuric acid. For the cathode, plates of lead or lead and antimony alloy are good; they should be varnished at the back, at the edges, and along a narrow margin on the front. The anodes should be made of electrotype copper.—Lond. *Elec. Rev.*, May 11.

Electrolysis.—DEWAR.—An abstract of the second of his series of lectures on "A Century of Chemistry at the Royal Institution" (Digest, May 26). He refers to Grotthus' theory of electrolysis, which was first suggested by Davy, and says that it had to be subsequently rejected because of its utter inability to explain the difference in concentration produced in the electrolyte in the neighborhood of either electrode; this could only be explained by the migration theory, now generally accepted as true. He referred to Davy's experiments in decomposing potash and proving the elementary nature of phosphorus and sulphur and to his research on chlorine.—Lond. *Elec.*, May 11.

REFERENCES.

Automatic Coherer.—TOMMASINA.—A French Academy note, describing an automatic coherer in which there is a kind of carbon powder such as is used in the microphone of the Swiss telephone stations. He introduces it directly into a telephone receiver. A hole two millimetres in diameter is drilled into a plate of ebonite, which is filled with the carbon powder and closed with plates of mica. Two German silver wires are led in from the sides and press against the powder. The wire of the telephone magnet is cut and the coherer inserted. One dry cell suffices to work the coherer, the impact of each wave being indicated by a click in the telephone. He proposes to insert the coherer in the circuit of a Morse instrument, and in this way solve the problem of the rapid transmission of wireless signals.—*Comptes Rendus*, Apr. 2; *L'Elec.*, Apr. 28; abstracted in Lond. *Elec.*, May 11.

Oscillatory Discharges.—HEMSALECH.—An abstract of a French Academy note giving an account of researches on the spectrum from oscillatory discharges from condensers. He found that the oscillatory character of the spark was often completely changed by the introduction of an iron core into a coil of wire through which the discharge was passing.—*L'Ind. Elec.*, Apr. 25; *L'Eclairage Elec.*, Apr. 14; Lond. *Elec. Eng.*, May 11.

Mechanical Action of Cathode Rays.—GRAETZ.—An account of experiments showing that the rotation of small mill wheels under the action of cathode rays. cannot be regarded as directly due to the impact of projected particles. Even in vacuum tubes such rotations appear long before there is any indication of cathode rays, and they cease at exhaustions at which these rays are still present in full strength. Small spheres and vanes mounted on needle points and introduced into an electric field traversed by Röntgen rays, begin to rotate as soon as the radiations strike them. Some theoretical explanations are added.—*Ann. der Phys.*, No. 4; abstracted in Lond. *Elec.*, May 11.

Electrolytic Current Records.—GRUETZNER.—An account of experiments in which he uses filter paper prepared with a potassium iodide paste which he mounts on a revolving metal cylinder, the two electrodes consisting of platinum springs being lightly pressed against the paper. When a continuous current is used, the anode traces a brown line, due to the evolution of iodine, while the cathode leaves no trace. With an alternating current the two electrodes make alternate traces.—*Ann. der Phys.*, No. 4; abstracted in Lond. *Elec.*, May 11.

Electrical Exhibits.—An editorial note on some exhibits at the conversazione of the Royal Society. Trotter exhibited models illustrating leakage from electric tramways, consisting in surfaces constructed on three Cartesian axes, the vertical representing potentials distributed over the space adjacent to the tramway; equi-potential lines were shown in black and lines of current flow were drawn therefrom in red. A converse to de la Rive's experiment with a floating battery was shown by S. P. Thompson, small floating magnets enclosed in glass tubes taking the place of the battery; an immersed hollow coil carrying an electric current provided a sub-aqueous magnetic field by which the vagaries of the magnets were determined. Kerr showed a clock controlled by Hertzian waves, the maximum distance at present over which it can be controlled being about six miles. —Lond. *Elec.*, May 11.

MISCELLANEOUS.

Aluminum-Magnesium Alloys.—THURSTON.—An article referring to Mach's magnalium (Digest, Oct. 21, Nov. 11), and stating that he made an experimental investigation of the elastic properties of aluminum-magnesium alloys and published the results in 1893, some of which he reproduces. "Dynamos have been constructed, in the shops of Sibley College, of aluminum, and a gain thus secured for portable and automobile work of some importance, and it is possible that magnesium, with its higher tenacity and greater lightness, may prove the coming material for some such work. Costs will undoubtedly fall rapidly with increasing area of market."—*Science*, May 18.

Electro-Culture.—A note on experiments made by some Russian scientists. "Electrified seeds" germinated more rapidly, and gave better and quicker results than seeds which have not been submitted to preliminary electrification. When a vertical copper plate and a vertical zinc plate were buried in the soil and connected by a wire, potatoes and roots grown in the "electrified" space, gave crops three times heavier than those which were grown close by on a test plot, the carrots attained quite an unusual size of from 10 in. to 12 in. in diameter. In other experiments wooden posts were planted about 10 yards apart, provided at their tops with metallic aigrettes, connected by wires so that the plants were cultivated under a sort of network of wire; some remarkable results were obtained, and ripening barley was accelerated by twelve days.—*Sc. Amer., Sc. Amer. Sup.*, May 19

REFERENCES.

Wireless Telegraphy.—FERRIE.—A long article giving an illustrated description of the apparatus used in the station for wireless telegraphy at Wimereux, near Boulogne, in France, and giving an account of experiments made there with messages sent to the station at

South Foreland at the English coast. The following conclusions are drawn. In order that wireless telegraphy may render the same services as ordinary electric telegraphy or even as optical telegraphy, it would be necessary that in a number of stations any one can transmit different telegrams to several others at the same time, and receive at the same time several different telegrams coming from others; this condition is far from being fulfilled. Furthermore, there is no secrecy of the correspondence. Nevertheless, wireless telegraphy is said to be practicable in numerous applications for the war, for marine and commercial purposes, and in the colonies.—*Revue du Genie Mil.*, v. 18, pp. 230, 437; abstracted at some length in *L'Eclairage Elec.*, Mar. 31.

Switzerland.—The first part of a very long abstract of the official report on telegraphy and telephony in Switzerland in 1899.—In an editorial, reference is made to the fact that the number of telegrams in Switzerland during the last ten years has decreased by 15.5 per cent; also to the explanation which is given in the report, that the decrease of the number of telegrams occurred mostly in those cities in which telephony was installed. This reason is questioned in the editorial. The number of telegrams between Switzerland and other countries has increased.—*Elek. Zeit.*, May 10.

Fire Alarm.—An illustrated description of an automatic fire alarm and temperature indicator for distant points, devised by Vila y Forns, of Gerona. A thermometer has platinum wires inserted in the stem, at distances of five degrees apart, so that the mercury touches the extremities of the wires at the indicated degress of temperature. The wires lead to an indicating switchboard consisting of a semi-circle, in the centre of which a switch arm may be turned. If the latter is placed in contact with the button marked 20°, an electric current is closed through the mercury of the thermometer when this temperature has been reached, and a bell rings.—*La Vie Scient.; El'ty*, May 23.

Electrolytic Production of Coloring Matter.—Szarvasy.—A longer French abstract of the German article noticed in the Digest Mar. 10. —*L'Eclairage Elec.*, Mar. 24.

Coloring Matter.—An article on recent methods of the electrolytic preparation of organic coloring matter, taken from patent specifications.—*Electrochem. Rev.*, January; abstracted in *L'Eclairage Elec.*, Mar. 24.

New Books.

Machinists' and Draughtsmen's Handbook. Containing Tables, Rules and Formulas, with Numerous Examples. By Peder Lobben. New York: D. Van Nostrand Company. 438 pages, 193 illustrations. Price, $2.50.

Although there are handbooks and pocketbooks (so called) innumerable on all branches of engineering, and though it seemed that there was no room for originality in the treatment of these subjects, yet the volume before us shows a distinct individuality and is not a mere duplicate of other works of the same class. The author states in his preface that he is a working mechanic, and this we can easily believe after perusing his pages. There is a directness of connection between the arrangement of the contents and the problems that present themselves to the practical workman, which appeals to the reader who is used to handling tools, but which may not meet the approval of those who judge the work from a purely scholastic point of view. It is for the benefit of the former class that the author has written the book, as he states in the preface.

Although the author modestly disclaims being anything but a plain mechanic, the book is not deficient in the mathematical treatment of such subjects as require it. For example, the section on strength of materials gives all the formulas necessary for ordinary calculations of the strength of beams, shafting and other parts of machinery, without going into the theory further than necessary to make the formulas intelligible. In the section on screws is given a method of cutting metric threads in a lathe furnished with a lead screw of inch pitch. This method, although exceedingly simple and perfectly accurate, is not generally known among machinists, and we have never seen it in print before. Along with this kind of information are shown cuts of commercial forms of bolts and screws. There are tables of squares, cubes, roots and reciprocals, of natural and logarithmic sines and tangents, of common and hyperbolic logarithms, etc. We think the author has succeeded in making a book that is useful to the class of readers for whom he wrote it, and, incidentally, to some others besides.

Hilfsbuch fur Die Elekbrotechnik. Von C. Grawinkel und K. Strecker. Berlin: Julius Springer. 732 pages, 330 illustrations. Price, 12 marks.

This sixth edition of this admirable electrical handbook has been thoroughly revised by Dr. Strecker, and brought up to date, as is yearly attempted. New sections have been added concerning methods of plotting alternating-current curves and their analysis, as well as a few pages of general remarks about electric heating apparatus of different types and the purposes for which these are used.

The chapter on electro-plating as well as the industrial application of electrolysis has been revised and much enlarged, there now being a very complete collection of formulæ for cleansing and plating solutions with numerous practical hints. There are further descriptions of processes utilizing electricity for the synthesis and breaking up of organic and inorganic compounds on a commercial scale.

The valuable sections have been retained, showing in a tabular form the characteristics of standard apparatus of different German makers, temperature coefficients of alloys, sensibility of instruments, characteristics of irons and steels, reduced illustrations of cross-sections of dynamos and motors, with notes as to the capacities in which these are built and their principal characteristics, and the same for transformers and storage batteries.

While some of the matter, such as the elaborate rules adopted by the Society of German Electrical Engineers for the equipment of electrical installations, is of local application only, the book contains page after page of exceedingly valuable engineering notes and data, and with its complete index should prove a good friend as a ready reference book for those engaged in electrical pursuits who are fortunate enough to be able to read German. It is only unfortunate that the thoroughness with which the field is covered prevents the book being made small enough for the pocket, in spite of its thin paper and semi-flexible covers.

Mechanical Movements. Powers, Devices and Appliances used in Constructive and Operative Machinery and the Mechanical Arts. By Gardner D. Hiscox, M.E. Third edition. New York: Norman W. Henley & Company. 402 pages, 1649 illustrations. Price, $3.00.

Unlike several other books treating of mechanical movements, the present one uses almost entirely illustrations of actual applications of movements instead of mere diagrammatic representations. Neither the title nor sub-title gives, however, a clear indication of the contents. For example, several pages are devoted to representations of the rigging of ships and kinds of rope knots and hitches. In the electrical portion are views of a number of dynamos, a street railway truck, an electrical gas lighter and a number of other subjects which, while coming under the head of appliances, seen somewhat out of place in this book. Among the 1600 odd engravings, however, are included the principal mechanical movements and many of the more rare ones which it would be difficult to find elsewhere.

Elements of the Theory of Electrical Engineering. A work bearing this title, from the pen of Mr. Charles Proteus Steinmetz, will appear in the Fall. As the title indicates, it will be an elementary work and will deal more particularly with dynamo machinery. The book will consist of two parts—Part I. treating of the "General Theory," and Part II. "Special Apparatus." The latter is divided into four sub-sections, as follows: A, Synchronous Machines. B, Commutating Machines. C, Synchronous Converters, and D, Induction Machines. The mode of treatment of the subject will be a simplified form of the methods of the author's well-known "Alternating Current Phenomena."

Directory of Electrical Societies, Etc.

Northwestern Electrical Association. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

American Street Railway Association. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

National Association of Municipal Electricians. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

American Electro-Therapeutic Association. Next meeting, New York, Sept. 25, 26 and 27, 1900.

Independent Telephone Association, Cleveland, Ohio, June 12-14, 1900.

American Institute of Electrical Engineers, Paris, Aug. 16, 1900.

The New York Works of the Western Electric Company.

The attention of the electrical profession has been attracted so largely to the development of heavy engineering, the construction of great central stations, railway power plants, transmission lines, etc., that few realize the present magnitude of establishments manufacturing such comparatively small electrical devices as telephones, annunciators, bells, etc. A consideration of the wide extent to which these smaller devices are used shows at once that somewhere there must be very large shops for their manufacture. The tremendous amount of apparatus used by Bell telephone exchanges throughout this country is—as is well known—entirely made by the Western Electric Company. While most of the large electrical manufacturing companies have established their works in small country towns or suburban places, the Western Electric Company has located in the heart of a large city each of the several factories which it has in America and Europe. Its works in Chicago and its former plant in New York City having become insufficient, the company began in 1896 the construction of a new factory in New York City which is now practically completed and in full operation. It will surprise many interested in electrical affairs to learn that in this one building in New York City there are employed some 3400 operatives, in addition to 5400 employed in the work of the same company in Chicago. An idea of how this compares with the work of other large electrical concerns can be obtained from the fact that the General Electric Company employs about 6000 hands in its many shops in Schenectady.

From this factory in New York City the output is almost entirely fine work, such as instruments, telephone receivers and transmitters, bells, and the elaborate arrangements of telephone exchanges, the coarsest work carried on in this factory being the making of lead-covered cables. All heavy work, such as the building of dynamos and motors, is carried on in the Chicago establishment. It is a well-recognized fact that apparatus made up almost entirely of such a great number of small, delicate parts as are embodied in telephone-exchange switchboards must be manufactured with much greater perfection of detail than heavier and less delicate machines of the same cost; otherwise the delicate apparatus will give an unwarranted amount of trouble. On account of the perfection of manufacturing processes necessitated by the delicacy of its output and the fact that this output embraces a very great variety of devices, the designs for which are constantly changing with the advance of the art, the economical operation of a factory of this kind is a peculiarly difficult problem. Fortunately this new factory was planned in its entirety before construction on it was begun, so that as it stands now it is a consistent and homogeneous arrangement of shops, with none of the disadvantages which necessarily exist in factories which have greatly outgrown their original plans and have been enlarged by additions and extensions. As for these reasons this factory is perhaps the most perfect electrical manufacturing shop in the world, its lay-out and methods are of unusual interest.

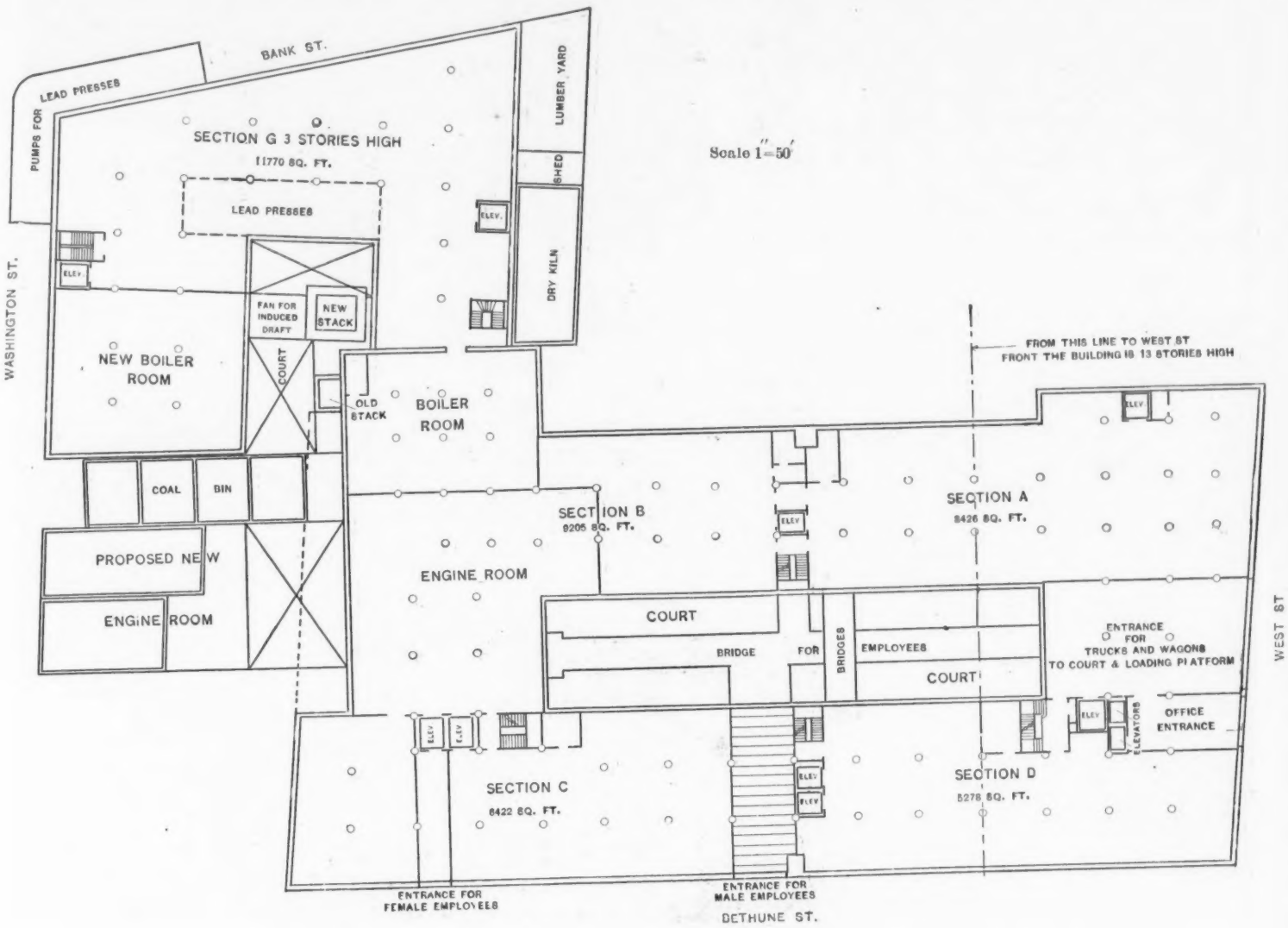


FIG. 1.—GROUND PLAN, WESTERN ELECTRIC COMPANY'S BUILDING IN NEW YORK.

THE BUILDING.

The building is located in the downtown district of Manhattan Island, the older or Lesser New York, facing four streets—West, Bank, Washington and Bethune. The first of these is the street fronting the North or Hudson River, the building facing this river on the west front and overlooking the piers of the White Star Steamship Line, where dock such fine examples of modern marine architecture as the Teutonic, Majestic and Oceanic.

The structure, as shown in the accompanying ground plan, is in the main 275 x 150 ft. in size and 10 stories in height, the West Street front being carried up to 13 stories to accommodate the offices, there being in addition a three-story annex outside of the main structure. This annex, as well as the space now occupied by the coal bins and that marked on the plan "proposed new engine room," will eventu-

ally be built up to a height of 10 stories, conforming with the rest of the building. The general design of the building is a hollow rectangle surrounding a rectangular central court about 32 x 150 ft. in size, which aids greatly in admitting light to the shop floors.

Structurally the building is of the most approved fireproof construction, the framework being entirely of steel, no cast iron being used; the floors being supported throughout on brick arches. To further reduce the fire risk and incidentally the insurance rates on shops of such large size, the building is divided into four parts by fire walls running from cellar to roof, these walls extending out from the central court to the four fronts of the building and cutting each floor into four sections, which for convenience in shop directions, etc., have been termed sections A, B, C and D. Thus the 10 floors of the shop are divided into 40 sections, readily designated as 1-A, 1-B, 2-A, 3-C, 4-B, etc. As will be noted on the plan these walls

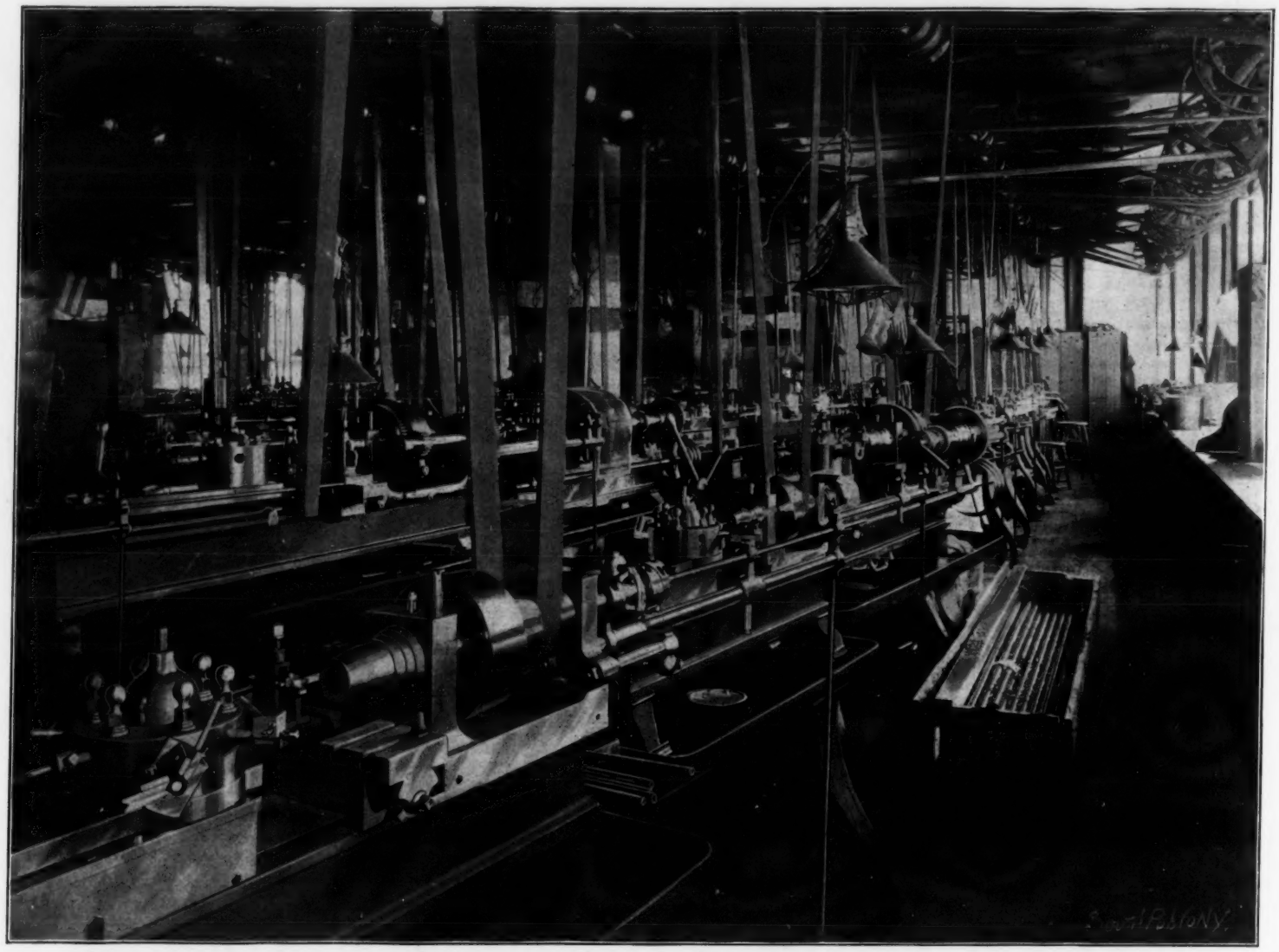


FIG. 2.—AUTOMATIC SCREW MACHINES.

are double and contain between them the elevators and stairways, thus cutting off these openings from the shops. The openings in these fire walls are guarded with automatic fire doors with fusible links. Further protection against fire is obtained with an automatic sprinkling system and a thermostatic alarm system. All windows opening on the court have metal sashes and wired glass. There is very little wood in the building, even the partitions being made of corrugated iron with iron doors. The floors are of wood for the sake of the comfort of those standing upon them all day, but the floor joists are laid in concrete, which comes flush with the under side of the flooring, preventing any access of air beneath it.

The central court is used as a loading platform for the receipt of raw materials and the shipment of the finished products, all of which are brought to and taken from the building in horse-drawn vehicles, railroad facilities being comparatively valueless in work of this kind, where the weight of the material handled is small compared with its value. The entrance of the courtyard contains two sets of scales by which the total and tare weights of incoming and outgoing loads can be obtained. The courtyard is roofed over on a level with the second floor, a covered bridge or gallery being built over the roof to serve as a general entrance and exit for employees. This bridge connects a broad staircase from the ground level with the various elevators and stairways in and between the four sections. By means of this general entrance the crowd of employees entering and leaving the factory is kept clear of the shipping rooms. Freight and passengers to different parts of the building are handled in nine freight and two passenger elevators, all of the Otis make and all deriving their power from the electric plant of the building from which power is also taken for the operation of all the machinery in the whole factory. The freight elevators are direct electric machines and the passenger elevators are hydraulic, supplied by motor-driven pumps. The elevator machines are in all cases located within the elevator shafts, which are cut off from the building by fire walls and fire doors from top to bottom, so that they will not serve to spread a conflagration. A unique feature of the elevator equipment is the housing of the switch gear of each elevator motor with its solenoid, carbon contacts, etc., in a fireproof cabinet.

The building is heated by means of hot water, which is in turn heated by the exhaust steam of the auxiliary engines, or live steam in case this exhaust is not sufficient. Without deducting the steam used for incidental purposes throughout the building, such as kettles, ovens, etc., the plant shows the very satisfactory economy of 260 or 270 watts per pound of pea coal. All water for all uses throughout the building, except for boiler feeding, is obtained from artesian wells sunk under the property.

GENERATING PLANT.

The electric generating plant which supplies current for lighting

and all power in the building has a rated output of no less than 1550 kilowatts and is probably the largest isolated plant in the world. There are four main units of 350 kilowatts each, consisting of Western Electric multipolar generators direct connected to Ball & Wood Corliss-type vertical compound condensing engines running at 150 r. p. m. There are also a 100-kw and a 50-kw set to carry light loads. The voltage generated is 120. The distribution is on the 120-volt, two-wire system, this system having been chosen owing to the large number of 110-volt motors and elevators taken over from the old plant. The usual output during the day varies from 7500 to 8000 amperes, most of which is used by motors. The total number of lights connected in the building is about 7500.

The motors are in all cases belted to line shafting, no individual motors being used for tools owing to the great number and small size of the latter. All motors are installed on the same plan, which is illustrated in Fig. 6; two cast-iron columns about 4 ft. apart are provided with brackets cast to them about 7 ft. above the floor. Laid over these brackets are two inverted channel irons on which the motor stands. Below the motor is a slate switchboard panel equipped with a circuit breaker, motor-starter, double-pole fused switch and a pilot lamp to indicate if current is on the supply feeder.

THE MAKING OF LEAD-COVERED CABLES.

One of the most interesting processes carried on in these shops is the making of dry-core, paper-insulated, multi-pair telephone cables. The first process in this work is the insulation of the wire. The bare wire is wrapped helically with long strips of paper by machines in the third floor of the annex. The two insulated wires, forming a pair—their insulation being of different colors so that they may be distinguished—are then twisted together. These twisted pairs are then cabled up in cabling machines, some of which are perhaps the largest in the world. That shown in Fig. 7 has six groups of drums and is capable of making a 250-pair cable. In the second floor are seven ovens for driving out the last traces of moisture from the paper insulation before the lead covering is put on.

In the basement of the annex are the presses for squirting out the molten lead in the form of a sheath about the paper-insulated cables. There will eventually be eight of these presses designed to work under the enormous pressure of 6000 to 7000 lbs. per sq. in. These presses are supplied with hydraulic power directly from a battery of three-throw pumps, each direct driven by an electric motor without gearing. The pumps and their motors run at the low speed of 100 r. p. m., making the motor of unusually large size for its output of 35 horse-power. The motor has a flywheel to reduce the fluctuations

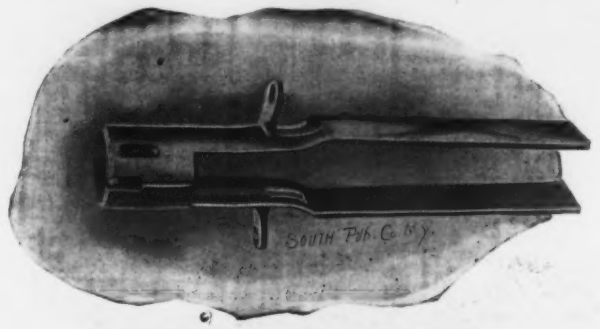
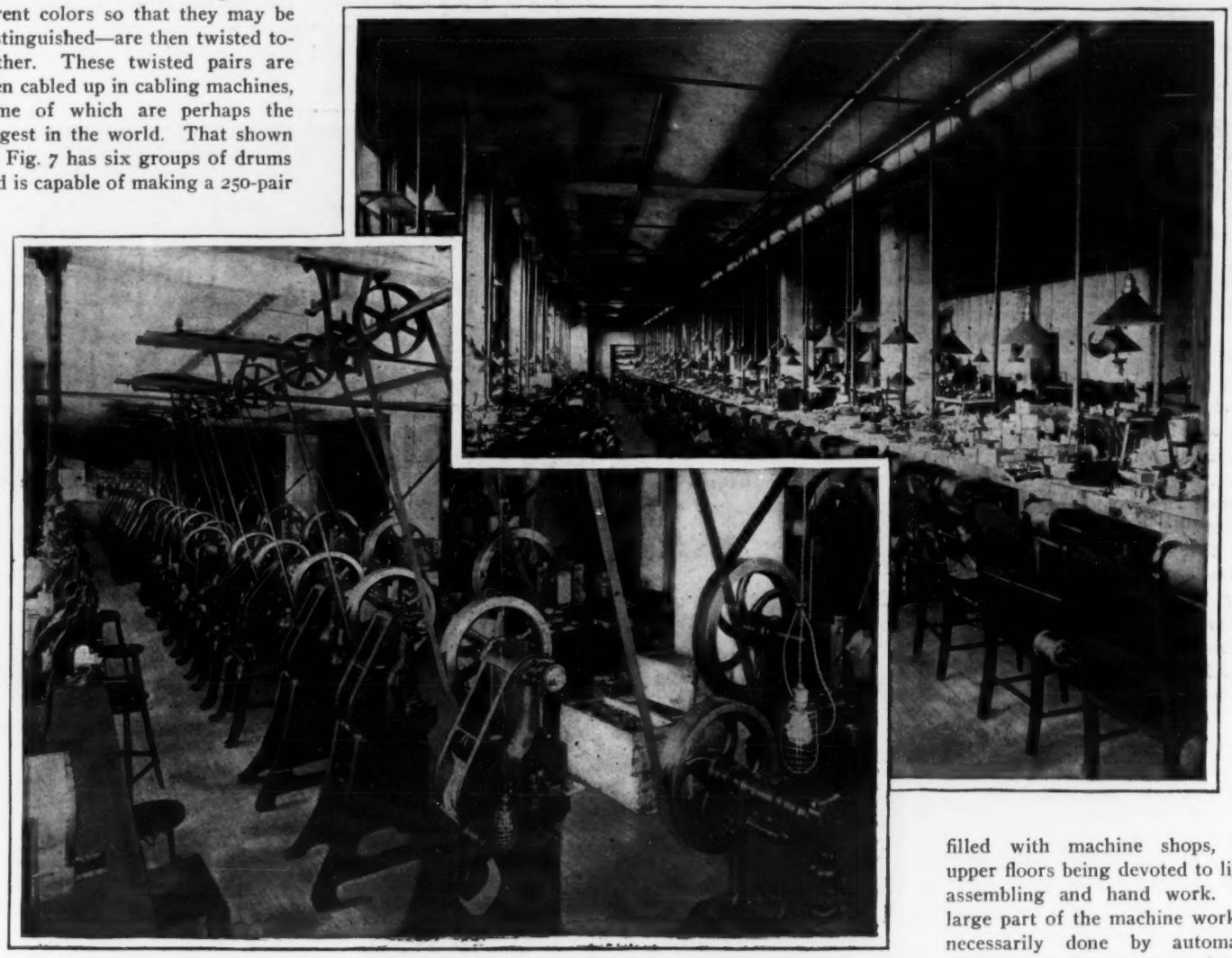


FIG. 5.—SOCKET FOR VISUAL SIGNAL LAMP.

of the armature current caused by fluctuations of the power absorbed by the pumps. In order to allow the motor to slow down and speed up sufficiently to make use of the flywheel effect the fields are compound-wound.

THE MACHINE SHOPS AND SOME OF THE WORK DONE IN THEM.

Of the main building the third, fourth and fifth floors are largely filled with machine shops, the upper floors being devoted to light assembling and hand work. A large part of the machine work is necessarily done by automatic means, since the output consists of a great number of similar pieces. In section 4-B, for example—*i. e.*, section B of the fourth floor—there are a large number of automatic screw machines which turn out finished details, such as binding posts and similar parts from the rough stock, all operations being performed automatically in one machine. These automatic screw machines resemble turret lathes, which automatically advance one tool after another, performing automatically on one piece of stock several



FIGS. 3 AND 4.—PUNCH PRESSES AND COIL-WINDING DEPARTMENT.

operations for which they are set. Pieces requiring five operations and having a diameter of less than 1½ ins. are turned out at the rate of about one per minute. Some of the automatic screw machines are capable of doing almost as elaborate work as a skilled machinist. For instance, in one type the work is first turned, faced and threaded on one end while being held in a chuck by the other end; an automatic hand then takes the work out of the chuck, turns it around and places it in another chuck with the other end exposed to be operated on by a new set of tools, while a new piece is put on the first chuck and goes through the preliminary operations on the first end.

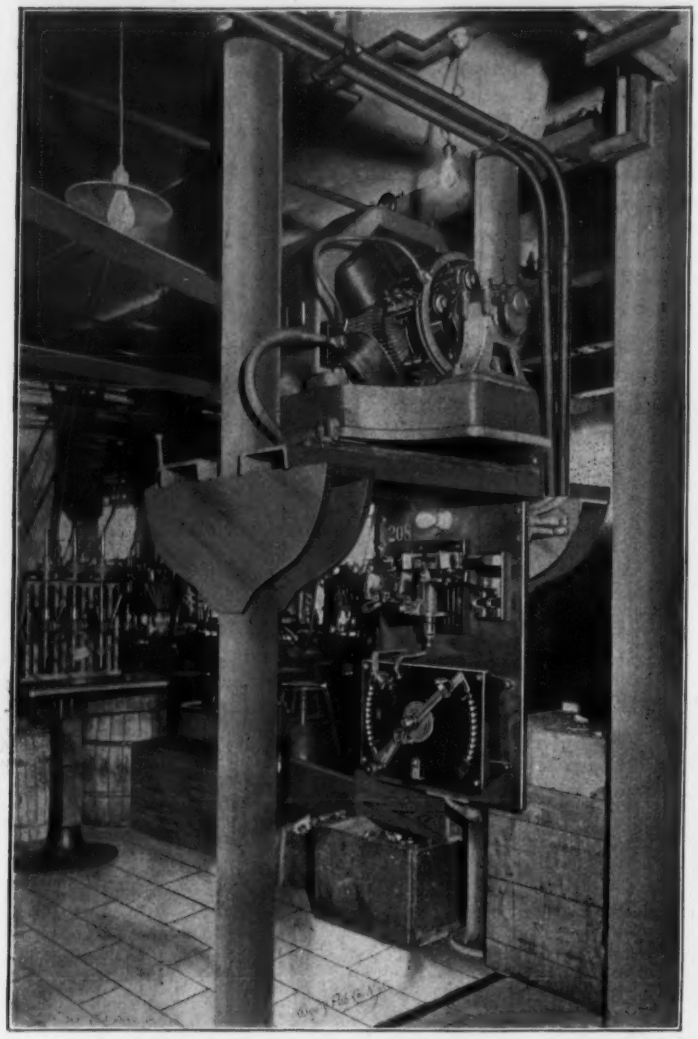


FIG. 6.—METHOD OF MOUNTING MOTORS.

In 4-D are the punch presses for stamping out the many thin brass and iron sections that go to make up the parts of telephone instruments and switchboards. Among them are compound punch presses capable of turning out complete, after a series of blows, such elaborate parts as, for instance, the socket for a visual-signal lamp, shown in Fig. 5. This socket, with its holes, prongs, indentations, round and flat parts, is turned out with four blows, a new piece of stock entering one side of the punch press and a finished socket leaving the other with every blow of the machine.

In 5-B are many milling machines with special fittings and attachments for automatically doing work unusually elaborate for milling-machine practice, even to such processes as screw-thread cutting. The milling cutters are not only set up in gangs, but the work is fed in to the machines in gangs, so that a number of surfaces may be finished on a large number of pieces all with one operation.

Great care is taken to have all work finished exactly to gage. For instance, on the automatic screw machines making plugs for telephone switchboards there are gages having two holes for the tip of the plug, the diameter of these two holes being 249-1000 and 251-1000 respectively, the tip of the plug must pass through one hole and not through the other before it is considered satisfactory. The gage has other holes for the sleeves and another gage is provided for the shape of the plug. In some cases the two limiting gages of the diameter differ by only 1-1000 of an inch. All work is carried on on a system of gages, either primary or secondary.

To show the variety of work done in this factory there may be cited as a contrast to the processes mentioned above the woodwork carried on in section 3-A. This woodwork is that for telephone switchboards, monitor operator desks, etc., and is necessarily, owing to the purpose for which it is made, the very finest grade of cabinet work, excelling undoubtedly even that of palace cars. The material used is Santo Domingan mahogany, aged and kiln-dried with great care in kilns within this factory.

The shops are so numerous and extensive that a complete description of them is out of the question. The total floor space in the factory being over 11 acres, nothing but a few notes as to the most interesting points can be given here.

In 6-B are the grinding and polishing machines and the nickel-plating machines. Powerful motor-driven fans are used to withdraw the dust and grit which are separated from the fan exhaust and burned in the furnaces. The nickel-plating room contains a 7½-hp motor-generator supplying the 15 plating tanks.

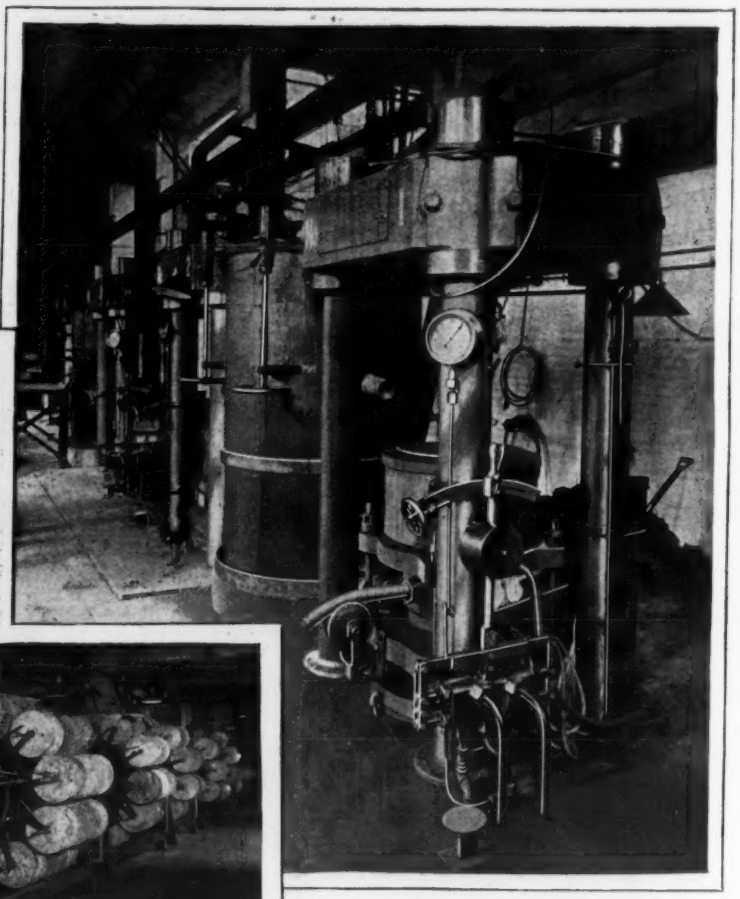


FIG. 7.—CABLING MACHINES AND SHEATING PRESSES.

In the japanning room, as well as in the rooms devoted to making condensers, there are electrical furnaces heated by iron-strip resistances on the interior walls, supplied

with thermometers for determining the temperatures and switches for adjusting them.

Ascending above the sixth floor the shops in which are carried on operations on the raw material are to a certain extent left behind, the upper floors being devoted to assembling, finishing, testing, etc. On the lower floors are carried on the milling, drilling and punching of iron and brass work and the insulation of wire—for which, by the way, the company makes its own machines. On the upper floors switchboards are assembled and wired, coils are wound, and all apparatus is inspected and tested. The stockrooms are necessarily scattered throughout the factory near the work for which their contents are specially adapted.

It may be interesting to cite a few of the operations carried out on the upper floors. In 7-D switchboard cables are measured out and soldered into the multiple jacks. In order to give at all times the best light for picking out the wires of different colors these rooms are illuminated with enclosed arc lamps. In 8-C 200 girls are engaged in winding small coils. The coils are rotated by power derived from a shaft running under a bench at which the girls work, each girl obtaining her supply of wire from a reel fastened on the back of her chair. The number of turns on each coil is accurately determined by a revolution indicator.

In 9-B is a room devoted to the making of rolled condensers. This room contains electrical ovens, similar to those described above, in which these condensers are baked out at a temperature of 240 degs. before being paraffined. In 9-D is the inspection department. To show the care with which apparatus is tested the number of tests of telephone receivers may be cited. Each receiver is tested to see if it will lift a given iron weight; is tested for continuity of its winding, for grounds between the winding and core, for polarity and for volume of sound. Banks of toll counters are connected up to a commutator by which currents are made, broken and reversed through them, the toll counters being read from time to time to see that they all record the same number of impulses. In 9-A are the electrical laboratory and experimental rooms. The former is equipped with accurate Wheatstone bridges, delicate Thomson galvanometers and other high-grade testing devices for determining resistances, capacities of condensers, etc.

Ferranti Open Type Rheostats.

It has hitherto, and still is in many cases, a common practice in switchboard work to mount a sliding switch or regulator on the main slate panel, to which is also attached the switches, instruments and other devices for controlling the dynamos and motors. These sliding switches usually consist of handle, bridge contact and a number of small terminal stops, these stops varying in number according to the regulation required. The actual resistance wire is usually coiled and mounted on various types of frames, and at intervals in its length connected by means of cable to the stops on the sliding switch. In many cases the resistance is some distance away from its switch, and then long lengths of cables are necessitated.

Many difficulties have been experienced with this arrangement. The bundles of cables are clumsy, and unless very well insulated are liable to break down. The resistance coils sag and touch, and overloaded joints will give out and open circuit on the resistance, and being stored away in an inaccessible part, renders repairs difficult, and the cause of them difficult to remedy, thus giving those in charge of the station continual worry.

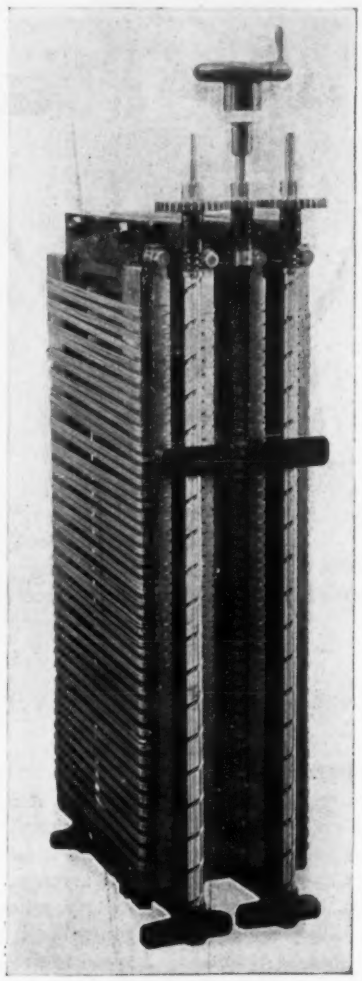
To obviate this trouble and to provide a resistance that is neat and compact, Messrs. S. Z. de Ferranti, Ltd., of London, England, have adopted what they term their open type rheostat, shown in the accompanying illustration of two complete resistances geared together. These resistances can be either used singly or any number of them can be geared as shown, and electrically connected either in series or in parallel.

The space occupied in width by each single regulator is 6 ins. They can be mounted directly on or below the switchboard platform, the hand wheel being placed on the top of the framework, which also contains exciting field switch and ammeter. Although these open-type rheostats have been specially designed for the Ferranti switchboard, they are quite suitable for use with any other design of gear. They are manufactured by Messrs. S. Z. de Ferranti, Ltd., Hollinwood, Lancashire, England, who have prepared a number of standard designs for currents ranging from 4 to 75 amperes and resistances varying from 100 to 0.5 ohms. Due to the large number of steps obtained (from 130 to 50) the drop per step is very low, allowing a gradual regulation; although the whole travel of the slides can be covered in about twelve turns of the hand wheel.

The rheostat is made strong and substantial in mechanical design and is most suitable for central station work as a regulator for any machine or circuit of any potential up to 600 volts.

The wire used is the result of some extensive experience. It does not deteriorate and is specially made to have a high resistance with a temperature coefficient practically nil. The wires are wound to an insulated framework in continuous straight lengths, there being no joints or sharp bends to break; by winding the wire in straight lengths coils are avoided and the trouble due to them sagging eliminated.

The stops are connected in a special way directly to the resistance wires, thus avoiding the usual inflammable bundle of cable connections, saving labor in connecting and prime cost of these cables, and at the same time reducing the number of terminals and nuts to two only, which connect the resistance to the circuit.



FERRANTI OPEN TYPE RESISTANCE.

The slider is designed with ample contact surface, and is made so that it cannot jump off the stops. A large radiating surface is obtained by using a number of small wires in parallel; this special feature renders any alteration easy to the particulars of the resistance, which can be increased by cutting away a few wires with a pair of pliers in any portion of the range.

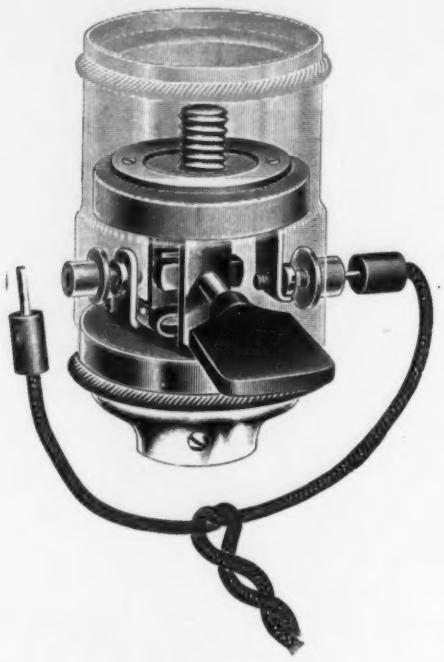
Socket Extension Tap.

The socket extension tap shown on next page is being placed on the market by the Socket Extension Tap Company of Boston Mass. Holes are bored in the shell of the socket by a punch furnished by the company, and porcelain bushings inserted therein. By inserting the pins in the holes, connection is made with the terminals, and extra light or power for fans, etc., may thus be obtained. The pins constitute the terminals of the flexible cord conductors, and are readily attached without solder or special tools. When the pins are inserted

either the fixture lamp or extension, or both, may be used by turning the key.

The illustration shows very clearly the manner in which the porcelain bushings are set in the socket shell and the method of making the tap connections for current extension.

This extension is readily applied to all styles of shell sockets without detaching the wires, and is constructed to meet the requirements



EXTENSION TAP.

of the Underwriters. Since no current-carrying parts are exposed there is no danger of short-circuiting, or of receiving shocks while handling.

Improved Motor for Electric Vehicles.

The Lincoln Electric Company, of Cleveland, Ohio, has recently brought out a new motor and controller, which, it is claimed, will increase to a considerable extent the mileage radius of such vehicles by recharging the batteries while the vehicle is in use. The motor in question is compound-wound, and so arranged that it may be used as a dynamo, thus charging the battery, whenever the vehicle is running down hill, or whenever the controller is moved from first speed to second speed, or from second speed to first speed. In other words, it is claimed that practically all the power now wasted as friction on the brakes is utilized in recharging the batteries. In descending a hill the speed of the vehicle can be controlled as easily and as perfectly as on a level.

For instance, suppose a vehicle having three speeds of 4, 8 and 16 miles an hour. When descending a 4 per cent or a 5 per cent grade, the speed of the vehicle will be about 5 miles an hour, and the batteries will be charging, it is claimed, at the rate of from 10 to 25 amperes, according to the weight of the vehicle and the steepness of the hill. If it is desired to descend the hill at a higher rate of speed, the controller is moved to the second speed, and the vehicle will descend at the rate of about 10 miles per hour, while the batteries will charge about twice as fast as before.

It is claimed that this motor has another and still more decided advantage over the ordinary series motor, in that the average efficiency is higher. At light loads it is claimed that the efficiency is very much higher. It is asserted that a vehicle driven by a series motor requires one-half and probably two-thirds as much current running down a 3 or 4 per cent grade as is required when running on a level. With the new Lincoln motor, however, it is claimed that the amount of current used is strictly in proportion to the load and the saving in current consumption is very great. It is claimed that by reason of the economies mentioned, a vehicle driven by this motor will travel from 20 to 40 per cent further than one driven by an ordinary series motor.

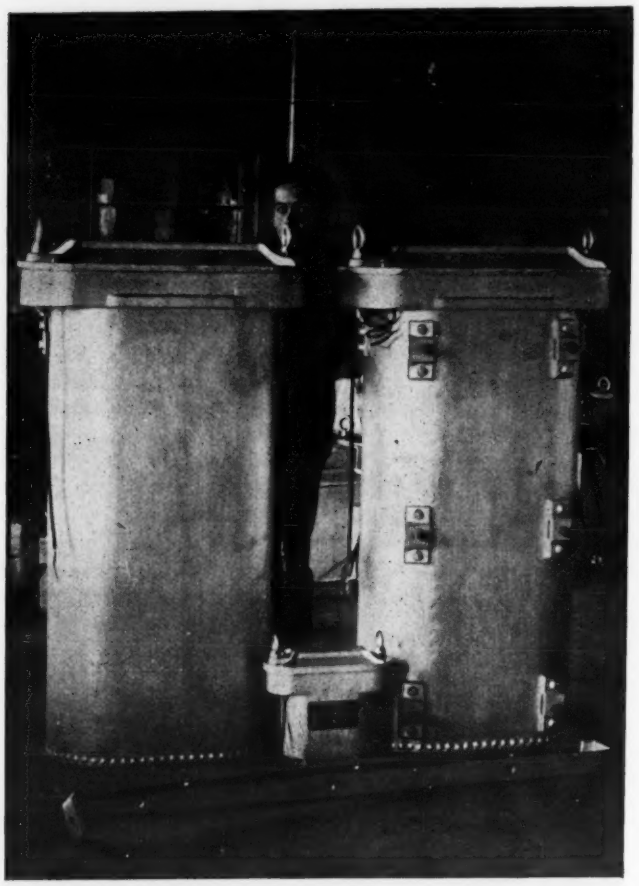
It is stated that recent comparative tests made in Cleveland showed that a vehicle equipped with a series motor required 13 amperes to drive it down a certain 4 per cent grade, while the same vehicle equipped with the Lincoln motor descended the same grade and charged the batteries 20 amperes.

The change of the machine from motor to dynamo is entirely automatic, and it is impossible for one sitting in the vehicle to tell whether the batteries are receiving or delivering current. The results mentioned are guaranteed and the invention is claimed to be a decided improvement in the operation of electric vehicles.

In general appearance the special motor is similar to the regular Lincoln series-wound motor. It is furnished in 1½, 2½, 3½ and 5-hp sizes. It is made with a cast-steel magnet frame, with the ends turned inward to protect the field coils. To each end of the cylinder thus formed are bolted the yokes that carry the bearings. Each yoke is fitted to a shoulder turned in at the end of the magnet frame to centre it. Each yoke carries a bearing for the armature shaft, one of them carrying the rocker and brush holders. A light and conveniently shaped aluminum cover is provided for this part of the yoke, so as to allow easy access to the brushes. The commutator is long and provides a generous brush surface. The motors are of the four-pole type, provided with ball bearings, laminated pole pieces of peculiar shape that give a very excellent distribution of magnetism over the pole surface; barrel-wound armature and reaction brush holders arranged for graphite or carbon brushes.

Peerless Transformers.

The accompanying illustration shows two 60-kw (1200-light) oil transformers (the small one shown in the centre is of 500 watts capacity), recently built for the Kennebec Light, Heat & Power Com-



PEERLESS TRANSFORMERS.

pany, of Portland, Maine, by the Warren Electric & Specialty Company, Warren, Ohio. One of these transformers is installed at Augusta, Maine, and steps up the voltage from 2000 to 5000, while the other, located at Gardiner, Maine, a distance of 6.7 miles, steps down the pressure to 2000 volts.

Distribution of Light from Incandescent Lamps.

The Shelby Electric Company, of Shelby, Ohio, has recently had a number of candle-power tests made of incandescent lamps, which it claims, show that the ordinary type of carbon used in incandescent lamps, namely, the single coil or the anchored carbon, distributes less than 6 candle-power directly below the lamp, the same lamp distributing 16 candle-power on the horizontal; and that in its own type of lamps where this condition does not apply, a saving of 50 per cent in current is effected on the basis of useful illumination furnished.

The explanation given by the Shelby Electric Company is that since artificial light was first used until the invention of the incandescent lamp, there has never been a source of light that would permit of a distribution of light rays directly beneath it. It was, consequently, not until the invention of incandescent lamps considered necessary to calculate the efficiency of any source of light on the basis that the light produced could not be radiated without casting shadows of the source of light itself or the burner. As the source of light or burner

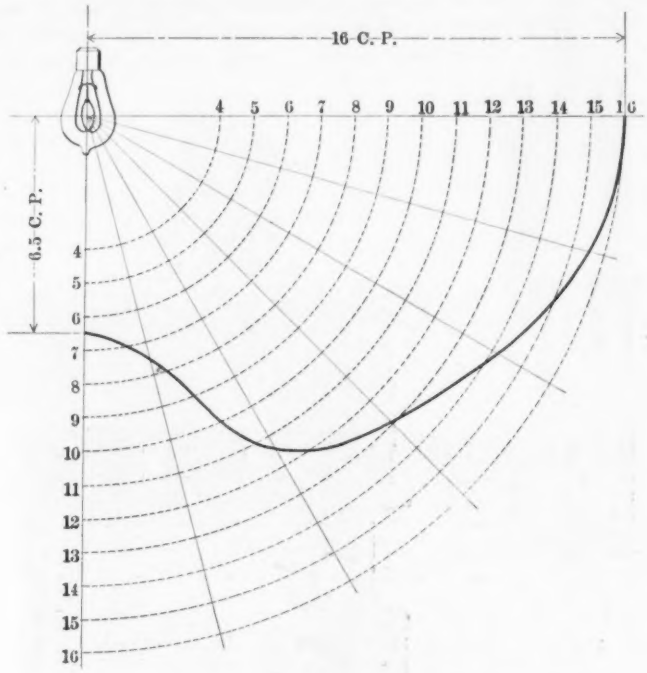


FIG. 1.—TIP BULB, DOUBLE TURN ANCHORED FILAMENT.

used in the production of light is underneath the light, the shadow would naturally interfere with the illumination directly beneath the source of light. This was so well established that when illuminating gas first came into use no one questioned the principle of judging the efficiency of light sources by a comparison of the quantity of light distributed in a horizontal direction from the source of light. As the light could not be directed downward, the most effective light was that distributed along the horizontal plane. When the incandescent lamp came into use, all of the accepted theories of illumination had been worked out on the basis of illuminating gas, and the manufacturers of incandescent lamps proceeded to make the incandescent lamp in a way that would distribute the largest number of light units on the horizontal plane. The lamps were measured with photometers practically the same as those used for measuring the candle-power of the gas burners, and they were measured horizontally from the standard. The greatest advantage of the incandescent lamp, namely, the advantage of being used without the casting of shadows, was thus completely overlooked.

The Shelby Electric Company claims that, as incandescent lamps are invariably located above the line of vision and sufficiently above to be out of the way of standing persons, and as the light is used to illuminate objects that are almost always below the line of vision for reading, writing, machine work, loom work, sewing, or, in fact, for any useful occupation, that the light radiated through the tipped end or top of the bulb becomes the useful light and, consequently, should be used as a basis for determining the efficiency of an incandescent lamp.

The accompanying curves are from tests made by Queen & Company for the Shelby Company. Fig. 1 shows curve of the anchored filament lamp. Fig. 2 shows curve of the triple filament of Shelby lamp.

Multiple Series G. I. Enclosed Arc Lamps.

The G. I. lamps shown in the illustrations herewith are for multiple series connection on direct-current, constant-potential circuits of from 200 to 600 volts or higher voltage, the only limitation being that each lamp shall have at least 90 volts and not more than 125 volts at the terminals. The ordinary conditions admit of two in series on 200 to 250-volt light and power circuits, and five in series on 450 to 600-volt power and railway circuits, in each case giving 150 life with half-inch by 12-inch solid carbons.

A difficulty heretofore met with in multiple series lamps, and one which is necessarily magnified as the number of lamps in the series is increased, has been to secure their perfect regulation and avoid the lamps "see-sawing" or "robbing each other" of their share of the potential of the circuit. This difficulty is claimed to have been entirely overcome on this type of lamp by using the differential method of regulation, and by giving the most careful attention to the design of the shunt and series winding, and to the magnetic circuit of the lamp.

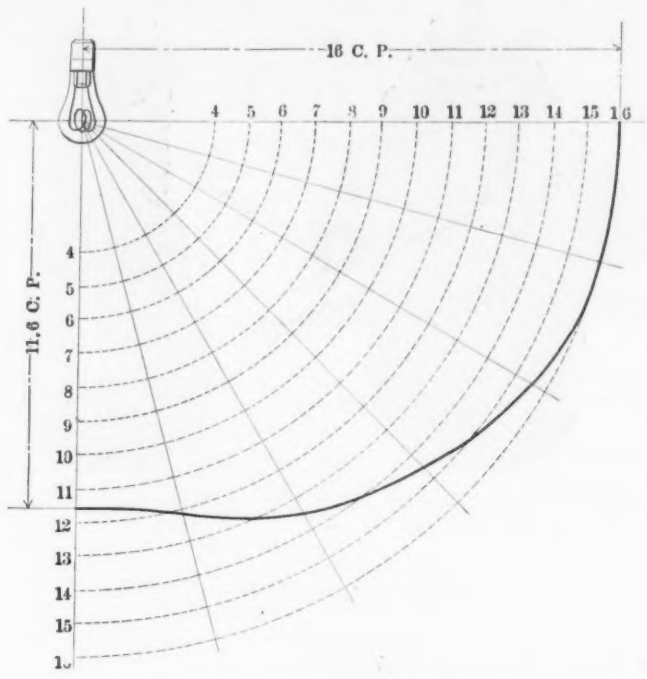


FIG. 2.—TIPLESS BULB, DOUBLE TURN ANCHORED FILAMENT.

Each lamp is equipped with an equalizing resistance, which by means of a carefully designed cut-out is automatically cut into the circuit in case the carbon should stick or burn out, thus balancing the circuit and allowing the remaining lamps in the series to continue burning without interruption. In the event of any lamp needing trimming or adjustment, a hand switch is provided on each lamp, which

FIG. 1.—LAMP WITH 12-INCH ROUND OUTER GLOBE.

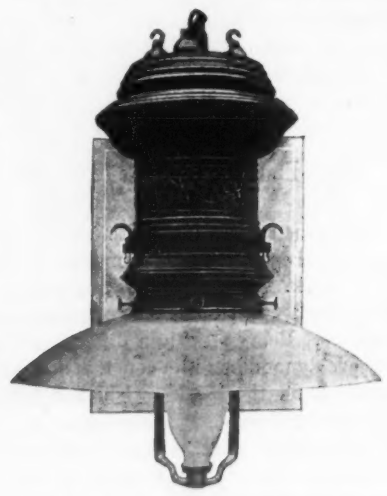


FIG. 2.—LAMP WITH PORCELAIN REFLECTOR, FOR WINDOW USE.

cuts in the equalizing resistance, allowing the lamp to be trimmed or adjusted without affecting any of the other lamps in the series. By

the use of carefully designed windings, which are of larger cross section than ordinarily used, and the automatic cut-out, it is claimed to be practically impossible to burn out the shunt windings.

A serious difficulty in many arc lamps has been the use of a sliding contact to make the necessary connection with the upper carbon holder. This troublesome form of connection has been entirely discarded, and in its place a substantial flexible wire connection of special design substituted, which has a margin of safety of 50 per cent above the necessary current-carrying capacity. This connecting wire gives a continuous electrical connection through the lamp, only broken by the arc.

A distinctive feature of the lamp is a new shadowless, and at the same time substantial trimming device. By referring to the cuts it will be seen that this device presents the least possible obstruction to the light and necessarily casts the minimum shadow. By pulling the trimming device down against the tension of springs, it may, on account of being hinged, be moved backward or forward, allowing the globe to be easily removed and giving full access to the carbon holders for re-trimming. Just above the inner globe the lamp is equipped with a porcelain-lined metal reflector, and much of the light from the arc otherwise diffused is reflected down, thus increasing the useful illuminating power of the lamp.

FIG. 3.—LAMP WITH OUTER GLOBE AND WHITE ENAMEL REFLECTOR.

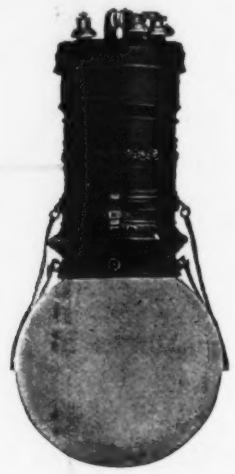


FIG. 4.—LAMP WITH 12-INCH ROUND GLOBE.

The shells of the lamp are constructed of brass, and are so designed as to be perfectly weatherproof, so that the lamps may be used either in or out of doors, and allow the use of either outer globe, porcelain reflector, or combination outer globe and enameled metal reflector; the three types being designated respectively as shown in Figs, 1, 2 and 3. In order, however, to meet the demand for a cheaper lamp for use in places where an expensive ornamental shell is unnecessary, these lamps are furnished, as shown in Fig. 4, with a plain iron shell enclosing the same mechanism. This shell is also designed to allow the use of either outer globe, porcelain reflector or combination outer globe and enameled metal reflector. The length of lamp with globe is 25 ins.—with reflector, only 23 ins. These lamps are wound for 5 amperes.

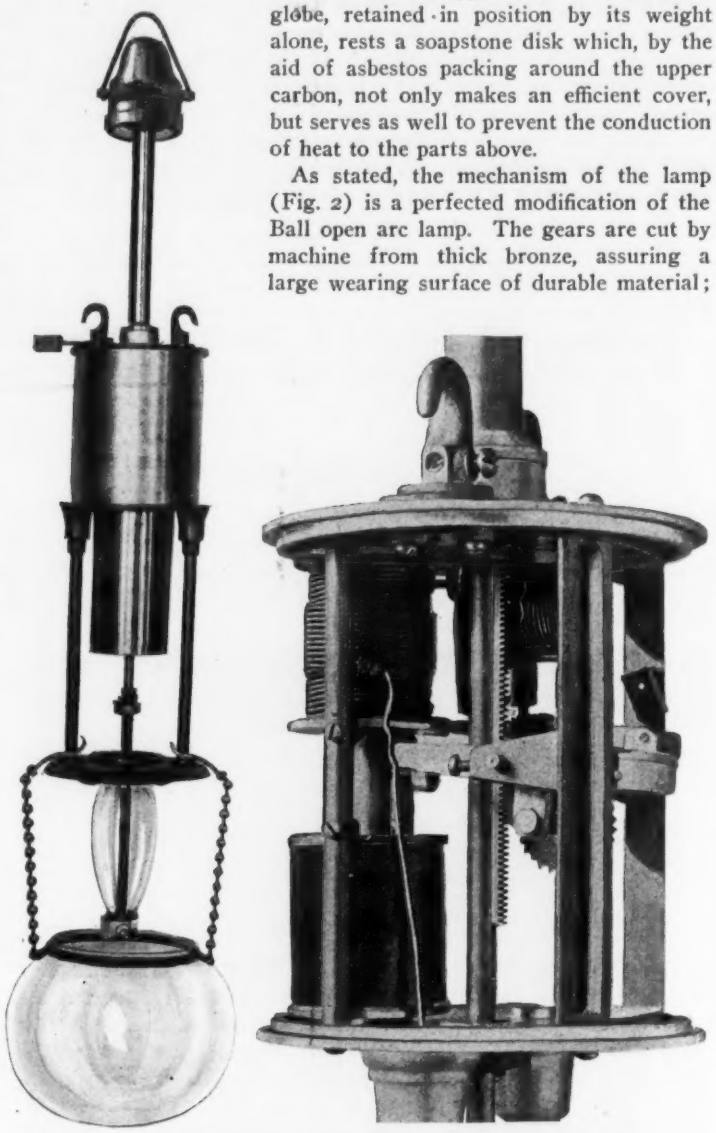
The Ball Differential Series Enclosed Arc Lamp.

The illustrations herewith show two views of a series enclosed arc lamp being put on the market by the Ball Electric Company, of New York. The lamp is designed on the well-known lines of the open-arc lamp made by this company, but contains a number of novel features. Being strictly a differential lamp, it may be operated from any arc dynamo, and its construction has been made such as to recommend it to those who wish for a combination of simplicity and durability.

The outside globe, shown dropped down in the engraving, is held firmly in a metal ring, hanging by two chains from the clutches seen on either side. These clutches when held horizontal slide easily on the supporting rods, but when pulled downward at their outer end by the weight of the globe, grip the rods most tenaciously. The removal of the inner globe is almost as simple. The lower end of the globe is closed by a valve-like disk on the inside carrying a projecting tube, on the outside being a second disk, which is screwed tight to the lower edge of the globe. The screw thread reaches only a short way down the tube, the end of which is turned true and, when clamped in position by the thumb nut shown in Fig. 1, is the entire support for the inner globe and lower carbon. The latter is held in the tube solely by friction, the sides of the interior having a slight taper.

In order that there may be sufficient directional effect, a bushing is turned at the opening of the tube so that a hole the exact diameter of the carbon remains. As the carbon must be pushed in some distance before being gripped by the taper, a rigid but extremely simple holder is used. On the upper surface of the inner globe, retained in position by its weight alone, rests a soapstone disk which, by the aid of asbestos packing around the upper carbon, not only makes an efficient cover, but serves as well to prevent the conduction of heat to the parts above.

As stated, the mechanism of the lamp (Fig. 2) is a perfected modification of the Ball open arc lamp. The gears are cut by machine from thick bronze, assuring a large wearing surface of durable material; three contact brushes are used on the feed rod to prevent its being pitted by bad electrical contact. There are no springs, but a gravity compensator allows a long arc to be drawn, and, should the lamp be cut out, lets the upper carbon fall firmly against the lower. In Fig. 1 the lamp is shown open ready for the removal of the inside globe. When in use an inner sleeve is pulled down from the cylinder, which appears to reach but half-way to enclose the upper carbon holder and rod.



FIGS. 1 AND 2.—DIFFERENTIAL SERIES ENCLOSED ARC LAMP.

Automobile Patrol Wagon.

The city of Akron, O., has had built an automobile patrol wagon from the designs of Mr. F. F. Loomis, of the city fire department. The entire electrical equipment, including the storage battery, was made by Mr. C. H. Loomis, of Akron. The wagon is to be used both in police patrol and fire department service. It has three speeds forward, two back, and a key for cutting the battery out upon leaving the wagon or in making repairs. The battery consists of forty cells, Willard type, the capacity of which is stated to be "13,440 watts at three-hour discharge." In the patrol station is a charging jack and an automatic cut-out for controlling the current.

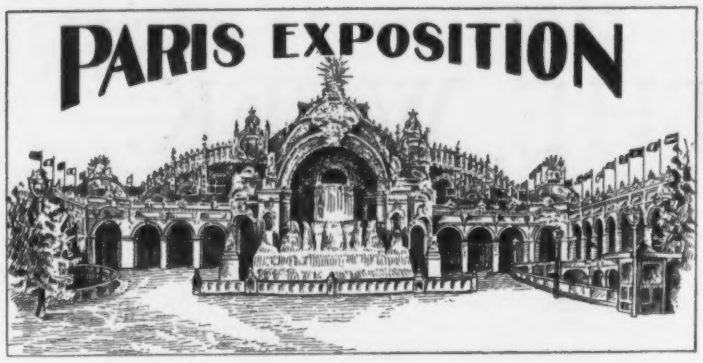


Exhibit of the McGraw Publishing Company.

The space occupied by the McGraw Publishing Company in Electricity Building at the Paris Exposition is on the ground floor, and is immediately in the rear of the Water Palace, which is the great feature of beauty and attraction at the Champ de Mars. It is naturally a part of the American section, which is distinguished more particularly from those of surrounding countries by having its spaces enclosed in an iron railing of uniform design, with large, handsome arc-light posts carrying each two lamps. Immediately back of the space is the alternating-current switchboard used in connection with the supply of current from the units in the service plant, and on the block itself are also the exhibits of the National Phonograph Company, with personal exhibit from Mr. Edison; Tinius Olsen & Co., of Philadelphia, and the Simonds Manufacturing Company, of

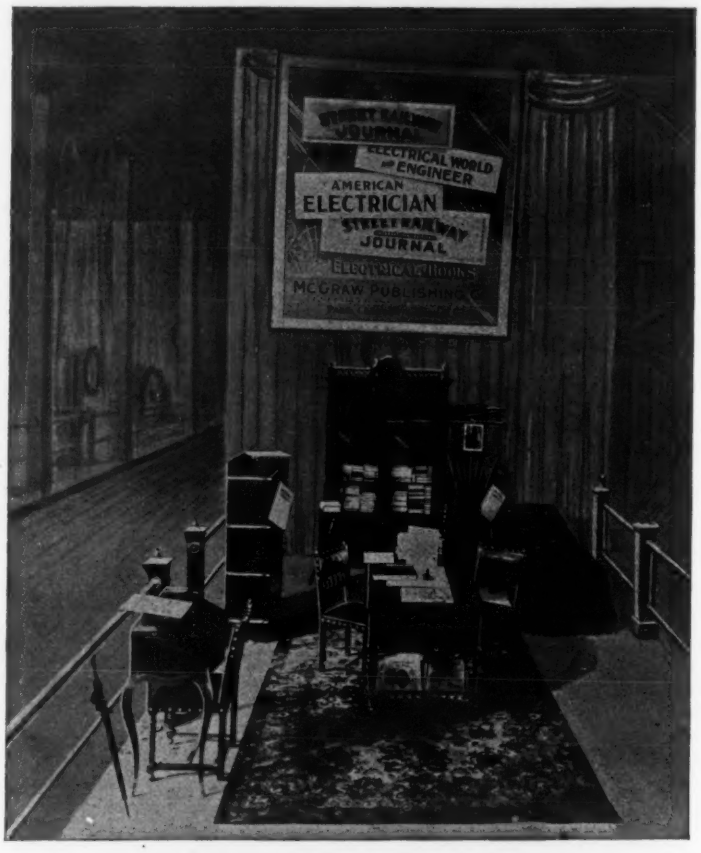


EXHIBIT OF THE M'GRAW PUBLISHING COMPANY.

Pittsburg, Pa. The two large spaces flanking the block are occupied by the Western Electric Company, with working apparatus in telephony, lighting, etc., and the General Electric Company, with a remarkable model of all its shops and photographs of some of its best installations. The gallery overhead embraces a large number of electrical exhibits and the various Salons d'Honneur in electricity and mechanics; and is reached by an adjacent grand staircase or by the sloping approaches from the Water Palace.

The 200 square feet occupied, with an alcove in the hollow steel column upon which the sign of the concern is placed, are utilized not only for exhibit purposes, but for the benefit of all electrical and mechanical visitors to the Exposition. There are shown bound volumes of the three periodical publications issued by the company—the *Street Railway Journal,* the ELECTRICAL WORLD AND ENGINEER and the *American Electrician*—and there is also on view a complete set of the fifty book publications that have come from its presses, and relating to all the branches of electrical science and industry. To meet the demand for these, a stock is also carried of such books as are likely to be of special interest to European readers.

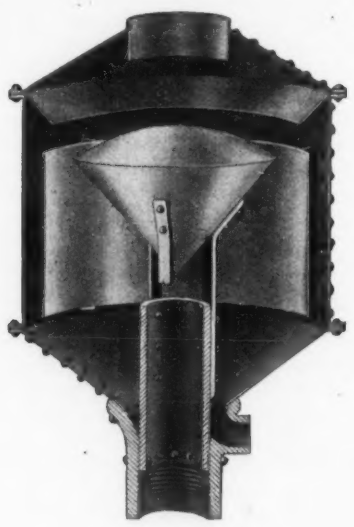
The central part of the space is given up to desks, chairs and divans for the benefit of visitors, and a register is kept of all engineers, etc., in attendance, supplemented by a card index, so that all inquiries can be promptly answered as to the location of any one in Paris, length of probable stay, etc. Current files of the three papers are also available, and copies of the latest issues to hand from America are distributed. The exhibit is in permanent charge of Mr. W. H. Donner, himself an engineer, and some of the editors and correspondents of the three papers are associated with him all the time in the preparation of the articles now appearing in them descriptive of the various exhibits and the features of the Exposition.

The space of the McGraw Publishing Company was the first in the American section of Electricity Building to be enclosed, and Mr. Donner has followed the growth of the Exposition from the first months of the year. The space was also the first to be occupied for steady work, although the terrible backwardness in the general power plant and exhibits has prevented the cosy corner from being of full benefit until quite recently. At Vincennes, in the Transportation Building, a file of the journal will also be placed for reference by visitors there. Bound volumes of the three papers have also been put, by request, into the official collection in the Department of Liberal Arts, and the three papers are also furnished regularly to the United States Publishers' Building on the Esplanade des Invalides.

Burt Exhaust Head.

The accompanying illustration shows the Burt exhaust head, which it will be noted, instead of being cone-shaped as in the case of the usual exhaust heads, has perpendicular sides. This gives a greater inside area and thus more room for the expansion of steam, and, consequently, reduced chance of back pressure. The area of the steam chamber is further increased by doing away with the usual baffle plates, diaphragms, etc.

The exhaust steam after coming in through the pipe, strikes the cone immediately over the inlet. This results in separating the steam



EXHAUST HEAD.

into fine particles, the greater volume of which rises up to the small projection extending around the top of the head, where it is held for an instant, during which the particles of water and oil drop by gravity down between the double walls on the side and out through the drip below. Owing to the greater amount of surface with which the steam comes in contact, more is condensed than in the usual form, and nothing but dry steam escapes; and since the steam has plenty of room to expand and escape, the vapor leaves the head noiselessly. The filter described is made by the Burt Manufacturing Company, Akron, Ohio.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—At the close of the week call money was quoted nominally 1¾@2 per cent. Time money was in more demand during the week, and is a little more attractive to the borrower, the rate for six months or more has fallen slightly. The rates are 3 per cent for sixty days to four months; 3½ for five months and 3½@4 for longer periods. Mercantile paper is quoted at 4 per per cent for prime single names. The weekly statement of averages of the Associated Banks shows an increase in lawful money of over $4,250,000. The inflow of money was largely from the interior, from which circumstance it is inferred that the demand for money throughout the country is falling off owing to reaction in prices and the lessening activity in general business. In the stock market the course of prices was rather irregular within narrow limits. Among the favorable developments was the termination of the Third Avenue receivership, an account of which is given on another page in this issue. The situation in speculation is probably somewhat affected at this time because of the disposition at this season to await crop developments. Another disturbing element is the usual effect of an approaching presidential campaign, which will be felt for some months to come. The market closed exceedingly irregular and featureless. As compared with the closing prices of a week ago the majority of stocks are lower. Among the net declines may be mentioned: Metropolitan Street Railway, ¾; Manhattan Elevated Railway, ¼ and American Steel & Wire, 1⅜. The closing quotations of electric and electric railway stocks were as follows: Brooklyn Rapid Transit, 71¼; General Electric, 134; Metropolitan Street Railway, 154; Third Avenue, 114¼, and Western Union, 80. Among the inactive stocks American Cable closed at 89; American Dist. Tel., 24; Commercial Cable, 160. In outside securities there was little change since our last report. Prices continue irregular. A slight improvement in several quarters is noted, however, and in some cases the closing prices were somewhat higher than those of the week previous. Among the industrials Otis Elevator attracted considerable attention by reason of the active demand for it. It is said that the profits on the company's business will insure the payment of a large dividend on the common stock, but when these dividends will be begun is still a matter unsettled. Among the electric stocks in this class of securities Electric Boat closed at 19; do. pfd., 34; Elec. Vehicle, 25; do pfd., 70; General Carriage, 7¼; Illinois Transportation, 1½; New England Transportation, 4; N. Y. Elec. Vehicle Transportation, 8½; Otis Elevator, 29¼; do. pfd., 87; Safety Car Heat & Lighting 115; Telephone, Telegraph & Cable of America, 5½ asked. In Boston the closing prices were: Boston Elevated, 140; Bell Telephone, 308; Erie Telephone, 101; Gen. Elec. pfd., 138¾ asked; Mexican Telephone, 1¾. General Elec. Automobile closed at ½ in the Philadelphia market.

LACHINE RAPIDS HYDRAULIC & LAND COMPANY.—The report for the year 1899 of the Lachine Rapids Hydraulic & Land Company, Ltd., shows that notwithstanding a large increase of expenses during the year all fixed charges have been paid, a stock dividend of 4 per cent declared, $18,000 placed to the credit of depreciation, and $2,457 carried over. During the year an expenditure of $413,000 was authorized for additions to the plant. The gross revenue for the year was $192,346 and the net profit after all deductions $59,128. The excellent showing of the company as thus far made is explained on the ground that the stockholders have paid one hundred cents on the dollar for the stock, not a dollar's worth of fictitious stock having been issued, and the equipment has been bought in the cheapest market for cash and is throughout of the newest and latest design. The assets of the company amount to $2,248,635, which includes real estate, interest in other companies, cost of plant and equipment, and cash on hand.

THE KINGS COUNTY ELECTRIC LIGHT & POWER COMPANY has had listed on the New York Stock Exchange an additional issue of capital stock of $30,000, making the total amount listed $1,980,000. The company's balance sheet as of May 1 shows: Assets, property and construction account, $3,143,261; Central Trust Company of New York, trustee, $1,000,000; stock in other companies, $5,175,770; discount, $100,000; bills receivable, $175,000; general accounts receivable, $950; cash on hand and in bank, $64,044; total, $9,650,025. Liabilities, capital stock, $1,950,000; first mortgage 5 per cent gold bonds, $2,500,000; purchase money 6 per cent gold bonds, $5,175,900; profit and loss account, $25,474; accounts payable, $7,651; total, $9,659,025.

THE AMERICAN ELECTRIC TELEPHONE COMPANY OF NEW JERSEY was incorporated May 10; capital, $3,000,000. The officers of the company are: P. C. Burns, president; Wendell P. Rice, vice-president; Charles C. Bulkley, secretary; Jesse P. Lyman, treasurer; J. G. Ihmsen, assistant treasurer. The head offices are in Chicago, Ill., 36 to 50 West Jackson Boulevard. The company purchased the patents, good will and assets of the American Electric Telephone Company, of Chicago; the Victor Telephone Manufacturing Company, and the Keystone Electric Telephone Company. These companies will continue to do business under their own titles, the Victor company changing its name to the Victor Telephone Works.

CONSOLIDATION OF ELECTRIC VEHICLE INTERESTS.—A Philadelphia despatch reports that an agreement has been drawn for the merging of the various Electric Vehicle Companies and the Anglo-American Rapid Vehicle Company. A new company, it is stated, will be formed to take over these interests. The Electric Vehicle Company is the parent and manufacturing company which controls the Pennsylvania Electric Vehicle, Illinois Electric Vehicle Company and similar sub-companies in New York and Boston and elsewhere, the par value of whose stocks aggregates some $80,000,000. The Anglo-American Company has $75,000,000 stock.

THIRD AVENUE'S LAST DIVIDEND.—Just before the Third Avenue Railroad passed into the hands of the receiver a dividend was declared but never paid. The question has been raised in some quarters as to whether there was any chance of its being paid. It is stated that there is little ground for hope of anything of the kind. No claims of this character were presented by creditors of the company, and it is thought to be unlikely that the Metropolitan Company will pay the amount.

LIGHTING PLANT FOR ELLIS ISLAND.—Through its agents, McClave, Hamilton & Rimmer, 85 Liberty Street, New York, the Ridgway Dynamo & Engine Company, of Ridgway, Pa., has just closed a $20,000 contract with the Government for the lighting plant of the new buildings on Ellis Island, in New York Harbor. A total of 425 kilowatts is to be required, and three 75-kw and two 100-kw direct-connected machines will be installed.

INCREASE OF CAPITAL.—The Boston Elevated Railway Company has petitioned the railroad commissioners for authority to increase its capital stock from $500,000 to $10,000,000. This petition is a formal matter. The Boston Elevated Railway Company on authority of the railroad commissioners issued $10,000,000 of receipts. Holders of receipts have paid in at the rate of $100 per share, and it is now proposed to exchange the receipts for stock.

DIVIDENDS.—The American District Telegraph Company of Brooklyn has declared a semi-annual dividend of 2 per cent payable June 11. The directors of the Columbus Gas Light & Heat Company have declared a dividend of 3 per cent on the preferred stock, payable June 15.

BONDS FLOATED IN LONDON.—Bonds for the construction of the Seattle-Tacoma Electric Railway Company's line, in the sum of one million dollars, have been floated in London. This will insure the completion of an important road.

INTEREST ON BONDS TO BE PAID.—The directors of the United Railways & Electric Company, of Baltimore, have formally announced that the semi-annual interest of 2 per cent. on the income bonds and the dividend on the preferred stock will be paid on June 1.

Commercial Intelligence.

THE WEEK IN TRADE.—In summarizing the state of trade throughout the country, on the basis of its weekly reports, Bradstreet's says that trade is, if anything, quieter, and prices lower than a week ago, while efforts toward a readjustment of productive capacity to present conditions are noted in several lines of industry, notably iron and steel and lumber. Unsettled conditions in the cotton trade and a large failure in that trade have tended to weaken quotations in several lines of speculative business. The deadlock in iron and steel still continues, the tendency being toward lower prices, the strength of export business being almost the sole supporting feature. Structural material, however, is the exception to the general market, being firm, with much hope in the direction of new business.

ENGINEERING SOCIETY LIBRARY, UNIVERSITY OF MICHIGAN

Business was relatively best in the Pacific States; in the Northwest distribution is of fair volume; in the South the cotton crop prospects are better as a whole, and in the East business is rather quiet, partly owing to weather conditions. Business failures for the week, according to Bradstreet's reports, number 167, as compared with 155 last week, 158 in this week a year ago, 231 in 1898, 257 in 1897 and 227 in 1896. There was little trading in the copper market, and there were few changes in price of any moment. The stock of the Great Lakes Copper Company was traded in for the first time, and advanced from $2.85 to $3 on fairly active trading. Union Copper was fairly active on one or two days, between 5 and 6. Amalgamated Copper was duller than it has been during any week of late and at the close of the week showed only a fractional net change. Closing quotations were: Lake Superior ingot, 16¾c. to 16⅞c.; electrolytic, 16¾c.; casting stock ingot, 16⅜c. to 16¾c. The price of platinum has advanced owing to the increased consumption. For ingot platinum in large quantities $18.20 per Troy ounce is quoted in New York.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended May 26: Antwerp—27 cases electrical material, $4,384. British East Indies—1 case electrical goods, $41. British Australia—10 cases electric motors, $823. Brussels—59 packages electrical material, $2,647. British West Indies—13 packages electrical material, $564. Bristol—3 packages electrical material, $350. Bologna—5 packages electrical material, $125. Bradford—10 packages electrical material, $1,188. Chili—65 packages electrical material, $2,731. Central America—1 case electrical material, $10. Cuba—17 boxes electrical material, $630. Darlington—1 case electrical material, $165. Genoa—18 packages electrical material, $6,505. Glasgow—20 cases electrical material, $1,002. Garran—6 cases electrical material, $300. Havre—17 cases electrical machinery, $9,025; 147 packages electrical material, $26,964. Hamburg—80 packages electrical material, $10,184. Liverpool—14 cases electrical material, $598. Lisbon—652 packages electrical material, $8,703. London—34 cases electrical material, $1,587; 240 packages electrical machinery, $26,622. Mexico—15 packages electrical machinery, $533; 63 packages electrical material, $2,353. Manchester—6 cases electrical machinery, $3,415. Naples—62 packages electrical material, $17,118. New Zealand—10 cases electrical material, $159. Odessa—7 packages electrical material, $607. Puerto Rico—36 packages electrical material, $360. Peru—511 packages electrical material, $32,254. Riga—6 cases electrical material, $1,500. San Domingo—399 packages electrical material, $4,187. Stockholm—1 case electrical material, $110. Southampton—19 cases electrical material, $642. U. S. Colombia—6 cases electrical material, $200. Venezuela—13 packages electrical material, $157.

ENGINE BUILDERS' ASSOCIATION.—Several of the most prominent builders in the United States of automatic cut-off engines have formed an association under the name of the Engine Builders' Association of the United States. The objects of the association are the promotion of the interests of the engine trade by the advancement of engineering knowledge and practice, cultivating a mutual respect and acquaintance, and the maintenance of a high professional standard among members; co-operation in matters of mutual interest; the correction of abuses; comparing and standardizing methods; promoting economy in operation; giving a better opportunity for work to employees and improved service to the public. Individuals, firms or corporations possessing a capital of at least $10,000 engaged in the manufacture of automatic cut-off engines, are entitled to not exceeding three memberships in the association from each concern, who shall be principals in the case of individuals or firms, and officers in the case of corporations, superintendents and general managers being eligible. The officers for 1900 are as follows: President, J. E. Sweet, Straight Line Engine Company, Syracuse, N. Y.; vice-president, W. M. Taylor, Chandler & Taylor Company, Indianapolis, Ind.; treasurer, H. L. Ide, A. L. Ide & Sons, Springfield, Ill.; secretary, S. F. Bagg, Watertown Engine Company, Watertown, N. Y.; members of council, W. R. Fleming, Harrisburg Foundry & Machine Company, Harrisburg, Pa.; C. A. Gates, Russell & Co., Massillon, Ohio; Thos. C. Wood, Ball & Wood Company, New York; S. B. Richards, Buckeye Engine Company, Salem, Ohio; John Dick, Phœnix Iron Works, Meadville, Pa., and Leonard Ames, of Ames' Iron Works, Oswego, N. Y.

STONE & WEBSTER PROPERTIES.—Coincident with the convention of the National Electric Light Association a convention of managers of the various electric light and street railway properties owned and controlled by Messrs. Stone & Webster, of Boston, Mass., was held in Chicago, the following gentlemen being present: W. C. Forbes, Russell Robb, G. E. Tripp, C. F. Wallace and H. L. Rogers, of the Boston office; D. P. Robinson, of the Seattle Electric Company, Seattle; A. M. Robertson, of the Minneapolis General Electric Company, Minneapolis; H. T. Edgar and M. M. Phinney, of the Lowell Electric Light Corporation, Lowell; H. G. Bradlee, of the Tampa Electric Company, Tampa; A. L. Drum, of Edison Electric Illuminating Company, Savannah; A. W. Leonard, of the Edison Electric Illuminating Company, of Brockton, and C. B. Kidder and A. Balsey, of the Terre Haute Electric Company, of Terre Haute. The business before this convention was the adoption of a uniform system of accounting for all the companies; the preparation of forms of engineering data, and the establishment of a general policy of management. The sessions were held in the Stone & Webster parlors, No. 1164 Auditorium Annex, and were so timed as not to interfere with the managers attending the sessions of the National Electric Light Association. The work in hand was under the direction of Mr. W. C. Forbes and Mr. Russell Robb, of the Boston office, and a large amount of detail work was accomplished, the results of which will make possible a complete comparison of the financial reports of the companies, which will be of great value to the investors in the securities of any of Stone & Webster's companies.

EQUIPMENT OF MEXICAN ELECTRIC RAILWAYS.—D. Mazenet, of the City of Mexico, general manager of the Mexican General Electric Company, is now in New York. As already announced in these columns, the City of Mexico Tramways Company, Limited, which is an English concern financed by Wernher Beit & Co., of London, is about to extend its road some 30 miles. At present the company operates about half that mileage. A number of contracts are now being let. Mr. Mazenet has brought with him an order for an 800-kw equipment, which will be supplied by the General Electric Company. The second road to utilize electrical motive power in Mexico will be the mule tramway which runs from the Mexican capital to the suburbs of Lerdo, Torreon and Gomez Palacios. The existing route is 16 miles in length. The General Electric Company, through its Mexican end, has secured an order for the initial electric equipment, which will comprise two 300-kw generators. Seven double motor equipments for cars will also be furnished by the same concern.

CABLE FOR ALASKA.—An order has been placed with W. R. Brixey for 187 miles of single-conductor submarine cable, to be laid across Norton Sound to connect the military points of St. Michaels with Cape Nome. This single order will amount in the aggregate to about $100,000. The cable will weigh in the neighborhood of 350 tons, and will be shipped on reels weighing each from 15 to 17 tons. The shipment will be made overland to the Pacific coast and thence by special cable steamer chartered for the work. The cable will be laid and be in complete working order by Sept. 5. This is an instance of how rapidly orders of such magnitude can be taken care of in this country.

PHILIPPINE CABLE.—The Safety Insulated Wire & Cable Company, New York, has received a Government order for 600 miles of single-conductor, deep-sea cable for connecting military points in the Philippines. It will be recalled that this same company shipped 212 miles of similar cable to the same destination on the transport Hooker less than a year ago. The first shipment of the recent order will be 200 miles, on the transport Burnside, which will arrive at New York June 1, and sail July 10. The remainder will be shipped in 100-mile lengths at intervals of two weeks.

CROCKER-WHEELER APPARATUS IN ENGLAND.—Some large English orders have been received by the Crocker-Wheeler Company this month, and this company is looking for a firmer footing on British shores than ever before. The inevitable confusion accompanying such a radical change as the moving of the general offices to Ampere, N. J., has now passed away, and F. S. Blackall, 39 Cortlandt Street, New York, is prepared to attend to all business in the States of New York and New Jersey.

CAR EQUIPMENT FOR THE BOSTON ELEVATED.—The Sprague Electric Company has been awarded the contract for the electrical equipment, except the motors, for 60 cars for use on the Boston Elevated Railway. It is stated that the contract involves about $100,000. It is reported that the motor equipment will be furnished by the Westinghouse Company.

ELECTRICITY IN A SUGAR PLANT.—A. W. Colwell, 39 Cortlandt Street, New York, has within the past few days closed several contracts for equipment for the new plant of the Marine Sugar Company, at Marine City Mich. The machinery in this plant will be electrically driven, and a complete electric light plant will be installed.

WAGNER FOREIGN AGENCIES.—The increasing export business of the Wagner Electric Company has necessitated the formation of several new foreign agencies and more are expected to follow. This company has its eye on the South African field and is looking for a good representative of its interests in that territory after the end of the present troubles in the Transvaal.

Special Correspondence.

ENGLISH NOTES.

London Office, ELECTRICAL WORLD AND ENGINEER,
May 19, 1900.

THE PARSONS STEAM TURBINE.—Information has been received that the firm of Messrs. Brown, Boveri & Company and the Parsons Foreign Patents Company, Limited, have entered into a contract for the manufacture and sale, for electrical purposes, of the Parsons steam turbine in France, Germany, Russia, Switzerland and Italy. The style of the company is Aktien-Gesellschaft für Dampf-Turbinen System Brown-Boveri-Parsons, with its head office at Baden, Switzerland. The combination is important in view of the position Messrs. Brown, Boveri & Company hold on the Continent as dynamo manufacturers. The high efficiency obtained from some of the plants constructed at the Heaton works for the Continent has no doubt been the chief factor in bringing about this arrangement with the firm of Messrs. Brown, Boveri & Company. The following figures extracted from the official returns of the exports of Switzerland show that the firm of Brown, Boveri & Company, on a total export of 4285 tons for 1898 contributed alone 1917 tons, or 45' per cent; and in 1899, out of a total of 5765 tons they contributed 2949 tons, or 51 per cent. Taking the proportion of increase over the year 1898, *i. e.*, 1500, it is shown that Brown, Boveri & Company participate in this increase to the extent of 1000 tons, or about 67 per cent.

ELECTRIC LIGHT AT THE VATICAN.—The *Pall Mall Gazette* publishes the following from its representative at Rome, which is most interesting as showing the forward movement of electric lighting in such a conservative institution as the Vatican: "As I have many times pointed out, the Vatican, the most conservative of institutions, is slowly, and most reluctantly it must be confessed, giving way to the trend of modern ideas. First His Holiness, much against his will, had steam-heaters set up in his apartments. Next Rome was startled by hearing that the Catacombs, sacred to mystery and candle-light, had been lit without reserve, from end to end, by electricity. Later the Apostolic Palace followed suit, and now we are told that at the approaching canonization on May 24, St. Peter's itself will be ablaze with electric light. Any one who has assisted at this most gorgeous ceremony will remember the myriads of twinkling candles in the apse, behind the high altar. There are suspended from the roof 1000 candelabra, two of which carry 800 candles each, so that the individual candles are about 20,000. All burn from 9 a. m. to 5 p. m., and about 100 men are employed to light them. The 'advanced' party at the Vatican wishes to make each of these an electric light. The 'retrograde' party protests against the desecration, the breaking of old customs, and the danger of new-fangled ideas; and thus the matter stands at present."

THE AUTOMOBILE LONG-DISTANCE TRIALS.—The motor-car trial has just been brought to a successful finish, the final run being from Nottingham to London, a distance of 123½ miles. The cars had already covered 937¼ miles, while those who took part in the optional hill-climbing competition on Sharp Fell had traversed another 20, and there was still another 28 to be added to the totals of those who competed in the flying mile test in Welbeck Park. All the cars, therefore, which have gone through the trial have traveled a minimum of 1059¼ miles, while some of them have totalled 1107¼ miles. There have been 11 actual running days since the competing vehicles left London on April 23, the balance being made up of Sundays and one-day exhibitions. There have been seven days out of the 11 on which 100 miles or more was the distance traveled; the longest being the final run to London and the shortest being the 61½ miles' run from Kendal to Carlisle, which included a hill-climbing competition up Birkhill. At St. Albans a prolonged halt was made by the faster cars, so that a massed procession might be formed, and at 5 o'clock all that had arrived by then set off in line for London. The Hon. C. S. Rolls' car acted as pilot, and on one was allowed to pass. Large numbers of people had collected on the line of route through Hendon, Kilburn and Maida Vale, and great interest was excited by the procession along the Edgware Road, Oxford Street, Regent Street, and through Trafalgar Square to the Automobile Club premises in Whitehall Court. Until the official figures are published, it is impossible to state the actual number of cars which have gone through the trial from start to finish. It may be said without hesitation, however, that the tour has been an emphatic success, and has done much to familiarize the public with the efficiency of the motor-car.

General News.

THE TELEPHONE.

OCEAN SPRINGS, MISS.—The Cumberland Telephone Company has completed its exchange in this city.

ST. JOSEPH, MO.—The Citizens' Telephone Company, of St. Joseph, filed a statement of increase of capital stock from $100,000 to $150,000.

BOULDER, COLO.—At a meeting of the City Council the city attorney reported adversely on granting a franchise to the new telephone company.

TRENTON, N. J.—A sympathy strike was declared here a few days ago by the linemen of the Bell Telephone Company in order to assist their fellow-workers of Philadelphia.

WICHITA FALLS, TEX.—The Wichita Telephone Company has been incorporated. Capital stock, $1,000. Incorporators: Robert E. Huff, Joseph A. Kemp, J. M. Belt and others.

NEENAH, WIS.—The Wisconsin Telephone Company is making arrangements for the establishment of an underground system for its wires in the business portion of the city.

YANKTON, S. D.—The Missouri River Telephone Company has been incorporated at Yankton, with a capital of $10,000. Incorporators: Edward C. Ward, Thomas F. Ward, James V. Ward.

CISSNA PARK, ILL.—The Iroquois County Telephone Company, Cissna Park, has been incorporated. Capital stock, $2,500. Incorporators: Tunis Young, J. C. Sailor and Fred Breymeyer,

ELKTON, MD.—The Diamond State Telephone Company is erecting its line from Middletown, Del., to Elkton, via Chesapeake City. The company has completed its line in Cecil as far as Rising Sun.

PALESTINE, TEX.—The Palestine Telephone Company has been incorporated. Capital, $10,000. Incorporators: J. W. Ozment, E. L. Ozment, J. B. Hamilton, A. P. Henderson, all of Palestine.

CARLINVILLE, ILL.—The Macoupin Telegraph & Telephone Company, Carlinville, has been incorporated. Capital, $10,000. Incorporators: J. A. Fletcher, C. G. Heinz, R. Whitely, Jr., all of Carlinville.

IOWA FALLS, IA.—The new Hawkeye Telephone Company, which has its headquarters in this city, is at work putting toll lines and exchanges in a number of towns and cities of this and surrounding counties.

NORTH TONAWANDA, N. Y.—The Rawson Electrical Company of Ohio, which concern is the parent of the Home Telephone Company of Niagara Falls, was granted a franchise in this city by the Board of Aldermen.

GREENVILLE, OHIO.—The Greenville Home Telephone Company has been incorporated. Capital, $50,000. Incorporators: J. A. Reis, W. D. Rush, L. J. George, G. W. Hartzell, T. C. Maher, G. W. Moore, C. R. Leftwick.

WASHINGTON, D. C.—Mr. Charles Hewlitt, an employee of the Chesapeake & Potomac Telephone Company, was arrested a few days ago in the act of looting the cash repository attached to an automatic telephone pay-station.

BOSTON, MASS.—The annual stockholders' meeting of the Erie Telegraph & Telephone Company will be held June 12 in New York. Stockholders will be asked to consider and act upon the question of increasing the number of directors from 12 to 25.

JEFFERSON CITY, MO.—The Capital Telephone Company has been incorporated. Capital, $50,000. Incorporators: E. T. Orear, S. B. Jeffries, J. P. Porth, E. R. Hogg, H. McHenry, A. M. Hough, G. A. Fischer, all of Jefferson City; A. M. Hough, attorney, Jefferson City.

HARRISBURG, PA.—The Harrisburg Councils are being urged strongly to pass the ordinance giving the Harrisburg Telephone & Telegraph Company the right to erect its poles and wires in this city. The new company is after privileges at Middletown, Royalton and other nearby towns.

SPRINGFIELD, MASS.—The Massachusetts Telephone & Telegraph Company has petitioned the City Council for locations for poles and wires in this city. The company is constructing a long-distance line westerly from Boston, which will be operated in opposition to the Bell interests.

BALTIMORE, MD.—The International Interior Telephone Company of West Virginia has been incorporated in this city. Capital, $50,000. Incorporators: T. F. Wilcox, C. H. Hook, G. F. Jones, C. C. Hughes, D. S. Pindel, all of Baltimore, Md.; E. L. Ward, attorney, Baltimore, Md.

CHICAGO, ILL.—The governing committee of the Chicago Stock Exchange has put restrictions on the use of private telephone and telegraph wires. Taking effect June 1, all wires connecting offices of members and those of non-members will be under the control of a committee of arrangements.

MARTINSVILLE, IND.—A franchise has been granted the Mooresville Telephone Company for lines extending over Mooresville east to Waverly and Landersville, west to Putnam and Hendricks County lines. The officers of the company are: D. B. Johnson and H. C. Searce, president and secretary, respectively.

BRADDOCK, PA.—Nearly 200 telephones in the Allegheny County Telephone Company's system in Braddock were rendered useless by a fire which burned out No. 2 switchboard a few days ago. The fire was caused by a cross with a trolley wire. The Bell Company was also slightly crippled by the accident.

PHILADELPHIA, PA.—The Bell Telephone Company, of Philadelphia, is said to be reducing rates. Some subscribers have been seen by canvassers who offered new contracts to run a year. The terms offered were said to have been on a basis of a reduction from $120 to $108 per annum for a limited call service.

PITTSBURG, PA.—The local branch of the Bell Telephone Company is making a number of improvements in the Telephone Building on Seventh Avenue. Several additional switchboards are being put up, the dining room of the operators is being remodeled and enlarged and a parlor is added to the accommodations of the employees of the company.

PLAINFIELD, N. J.—The Plainfield Telephone Company has been incorporated. The incorporators are Andrew Dingler and Robert J. Emery, of Jersey City, and Henry J. Atkinson, of Red Bank. The capital stock is $15,000. The company will construct and operate an independent telephone system in Union, Somerset and Middlesex counties, New Jersey.

CLEVELAND, OHIO.—Many of the linemen employed by the Cleveland (Bell) Telephone Company struck a few days ago for an eight-hour day without a reduction in wages. The men now receive $2.50 and work 10 hours. The company offered to compromise on nine hours, but this was rejected. Thirty linemen employed by the Cleveland Electric Illuminating Company also struck for an eight-hour day.

BUFFALO, N. Y.—There has been a hitch in the settlement of the difficulty between the Bell Telephone Company and the linemen, and about 160 climbers and instrument setters are out again. A boycott has been declared upon the Bell Telephone Company by the United Trades and Labor Council on account of the strike. All union labor men have been notified of this boycott; and for every violation the person using the telephone will be fined $50.

GREENFIELD, IND.—Local capitalists have acquired a controlling interest in the telephone plant which operates in this city and throughout the county, and Seymour Morrisson has been elected president; George H. Cooper, vice-president, and William A. Hough, secretary and treasurer. The entire system has about 400 telephones in use, including the exchanges in Greenville, Fortville, Ingalls, and 20 toll stations. The system will at once be made metallic, and two new lines will be constructed, so that every point in the county can be reached.

ELECTRIC LIGHT AND POWER.

GULFPORT, MISS.—Ground has been purchased for the electric light plant at this place.

WAYNESVILLE, OHIO.—The town officials have decided to install a municipal lighting and water-pumping plant.

ALLIANCE, NEB.—The Alliance Electric Light & Power Company has been incorporated at Alliance, with a capital of $25,000.

MARLIN, TEX.—The electric light and power plant at this place has been sold to Mr. Fred Fratt, of Galveston. Consideration $15,000.

TWO RIVERS, WIS.—The contract for the new electric light plant and water-works system has been let to C. A. Inglehart & Company, of Chicago, for $66,000.

WEATHERFORD, TEX.—The City Council has granted a franchise to J. L. Sale to operate an electric light and power plant in the city of Weatherford for a period of five years.

PUEBLO, N. M.—The New Mexico Light & Power Company, of Pueblo, has been incorporated. Capital, $30,000. Incorporators: F. L. Cuddeback, E. L. Woods, both of Pueblo.

CLEVELAND, OHIO.—John Gill & Son have been awarded the contract for an addition which the Cleveland Electric Illuminating Company will make to its Canal Street power house.

MOUND CITY, ILL.—The Mound City Electric Company has been incorporated. Capital, $60,000. Incorporators: A. J. Dougherty, C. J. Murphy, S. D. Stouplet, all of Mound City.

CHICAGO, ILL.—The Zenith Electric Light Company, of Chicago, has been incorporated. Capital, $15,000. Incorporators: C. W. Buckley, L. J. Osburn, W. G. Husband, all of Chicago.

ELMIRA, N. Y.—The Elmira Water Light Company, of Elmira, has been incorporated. Capital, $1,000,000. Directors: Charles F. Ueblacker, Ross M. Lovell and E. Watson, Personius.

PARRAL, MEXICO.—The inauguration of the new electric light plant and telephone system of Parral, Mexico, recently took place. The plants were installed by T. T. Lane, an electrical engineer in Mexico.

WAUPACA, WIS.—The Waupaca Electric Light & Railway Company has installed a new 150-hp compound Corliss engine and two 75-hp boilers in its plant, as an auxiliary to the 210-hp water wheel now in use.

BETHLEHEM, PA.—The Bethlehem Town Council has executed a $70,000 contract for electric street lighting, calling for 77 arc lights to burn all night and every night, at 27½ cents per light, for a period of eight and a half years.

RICHMOND, VA.—A charter has been granted to the Richmond Electric Company. The authorized capital is $100,000. The officers and directors are all Richmond capitalists, except Vice-President Joshua Hale, of Newburyport, Mass.

PHILIPPI, W. VA.—At a recent special election for the purpose of voting on an electric light ordinance, there were but three votes cast against it. The town will be bonded for $6,000, and the bonds will be floated at 5 per cent. The plant will be erected at once.

SAN FRANCISCO, CAL.—The Shasta Electric Light & Power Company has been incorporated. Capital, $1,000,000. Incorporators: G. A. Knight, C. A. Warren, C. E. Green, F. S. Edinger, F. S. Knight, all of San Francisco, Cal.; Chilton, MacCorkle & Chilton, attorneys, Charleston.

TONAWANDA, N. Y.—The Board of Trustees has entered into a contract with the Tonawanda Power Company whereby the streets of this village are to be lighted for the next five years by electricity. The price to be paid is $77 per arc light. One hundred and twelve lights will be used.

HARTFORD, CONN.—The Union Construction Company has been organized to construct, equip and improve works for the generation of electric light, heat and power. The capital stock is $2,000. The stockholders are the Hon. E. D. Robbins, of Wethersfield; C. E. Swan, Hartford, and Charles E. Hubbard.

OSWEGO, N. Y.—The properties of the Home Electric Company, the Oswego Gas Company and the People's Electric Light Company have been sold to the People's Gas & Electric Company, of Oswego. The company is controlled by Street, Wilkes & Co., New York brokers, and the amount involved is $400,000.

ST. PAUL, MINN.—The St. Paul Board of Aldermen passed the ordinance granting a franchise to the Manhattan Light, Heat & Power Company, over the mayor's veto. The franchise is limited to 30 years, and provides that the company shall pay a gross earnings tax when one has been imposed upon its competitors.

ATLANTIC CITY, N. J.—About 100 linemen employed by the various electric companies struck a few days ago, demanding $2.75 for nine hours' work. The demand was acceded to by the Atlantic City Electric Light Company and the Atlantic Coast Telephone Company. The Delaware & Atlantic Telephone Company declined to pay the increased rate.

NEW ORLEANS, LA.—The 17 suits which were brought by the residents of St. Charles Avenue and Calhoun Street and in that vicinity several months ago to recover admages from the Edison Electric Light Company, for property destroyed by the disastrous fire which occurred on Feb. 26, 1899, have been compromised for a cash sum of money. It is understood that this sum is practically the amount sued for by the property holders and the insurance companies, which was $126,000.

OTTAWA, ONT.—A number of Chicago capitalists—Messrs. David Spencer Kegg, J. P. Wilborg, G. K. Clutton, W. H. Dayton and George H. Pope—have been incorporated as the Anglo-American Power Company, Limited, with a share capital of $5,000,000. The company proposes to acquire the Jenison water powers on the Kaministiquia River, near Port Arthur, Ont., and is empowered to sell and to distribute power, compressed air, electricity or power in any form from the Jenison properties.

THE ELECTRIC RAILWAY.

NORFOLK, VA.—The Citizens' Railway, Light & Power Company, of Newport News, has executed a mortgage for $800,000.

DEPERE, WIS.—The council has taken unfavorable action on the proposition of the Fox River Railway & Power Company to extend its line into the city.

ANDERSON, IND.—The last bridge crossing White River between Anderson and Muncie will be completed by the middle of June and the road formally opened July 4.

EAST LIVERPOOL, OHIO.—The Electric Railway Company is building an extension to West Market Street, which will be a considerable improvement of the company's property.

GREENWOOD, IND.—Surveyors have begun laying out the route for the extension of the Greenwood line south. The managers will build into Franklin notwithstanding the opposition.

NEW HAVEN, CONN.—The Stamford Street Railroad Company has filed an application with the city authorities for improvements, including extensions to Glenbrook, Springdale and Sound Beach.

NILES, OHIO.—The Mineral Ridge & Niles Traction Company has been incorporated. Capital, $50,000. Incorporators: A. A. Anderson, G. F. Arrell, J. E. McVey, H. M. Robinson and D. F. Griffith.

CAMDEN, N. J.—The United States Railway & Light Company has been incorporated, with a capital stock of $125,000. The incorporators are Frank R. Hansell, George H. B. Martin and William F. Eidell.

BARABOO, WIS.—The question of an electric railway between Devil's Lake and the Dells is again being strongly talked of. A franchise was granted to a company two years ago, but it has almost expired.

NORWICH, CONN.—The Montville Street Railway Company, connecting New London and Norwich, has been opened for traffic. This closes a 14-mile stretch in a through line between New York and Boston.

RICHMOND, IND.—The City Council has granted a franchise to J. M. Lantz and P. J. Freeman for an electric railway to run through Centerville, Cambridge City and Dublin, the work to be completed in 16 months.

MARINETTE, WIS.—The Peshtigo Town Board granted the application of H. C. Higging, president of the Marinette Street Car Company for a franchise to build an electric line from Marinette to that village, six and one-half miles Work will be started very soon.

FRANKLIN, IND.—The Indianapolis, Greenwood & Franklin Electric Railway Company is having trouble in securing the right of way for the extension of the road from Greenwood to this place. Several farmers have raised objections and refuse to sell the right at the figures deemed reasonable by the company.

KOKOMO, IND.—The Central Traction Company will begin grading the proposed line between this city and Indianapolis June 1. Ties have been purchased and an option on the Kokomo street railway secured and will doubtless be purchased. The line between Kokomo and Tipton will be completed first and opened by Sept. 1.

KENDALLVILLE, IND.—Prospects for the early construction of the proposed electric line from this city to Logansport are favorable, the necessary funds having been secured. Rochester, Warsaw and Allison are among the towns through which the line has been surveyed. The principal power house will be at Warsaw.

ANDERSON, IND.—The Union Traction Company has signed the scale of the Laborers' International Protective Union, agreeing to pay the prices set out therein per hour, nine hours to constitute a day's work. The union men regard the act a great victory for a large number of unorganized men in the employ of the traction company.

LAPORTE, IND.—The County Commissioners have annulled the franchise of the Northern Traction Company to build an electric line connecting this city with Michigan City. This leaves the field open to the Indiana Railroad Company of South Bend, owners of the South Bend, Elkhart & Goshen interurban system, and they say they will at once enter the field.

LOGANSPORT, IND.—The Indianapolis & Logansport Interurban Line Company is advertising for a contractor to assume entire charge of financing and constructing the road. The promoters have nothing to furnish but the franchise, it is said, and the proposition is not attracting capitalists very rapidly. The project is not likely to be successful this year.

PITTSBURG, PA.—The Monongahela Traction Company acted as host to a number of the scribes on the local newspapers a few days ago, taking them over their lines to Kennywood Park, where the Traction Company has spent $50,000 in improvements by the erection of a band stand, a ball park and other amusement features for the entertainment of the patrons of the road.

DAYTON, OHIO.—The strike on the People's street railway lines at Dayton has been declared off. The agreement provides for an adjustment of all future difficulties by arbitration and a wage scale of 20 cents an hour, nine hours to constitute a day's work. Time of men under waiting orders lost is to be allowed. They may join any labor organization, and all strikers may return to their positions without prejudice.

PERU, IND.—A right of way has been asked for from the commissioners by Nat. Covington, capitalist of this city, and until recently owner of the electric light plant, looking toward the construction of an electric railway between this city and Converse. The line will give the city an eastern outlet, also one toward Chicago by way of Rochester, should the Logansport and South Bend line be built as contemplated.

KOKOMO, IND.—The County Commissioners have granted a franchise for an electric railway line to G. W. Landan, C. E. Cowgill and James Lynn, trustees for the Kokomo, Wabash & Northern Electric Railway Company. This is a revival of the Kokomo-Wabash project. Immediate use will be made of the franchise. It covers highways running from Kokomo to Greentown, and to Pleva, Converse, Somerset to Wabash.

PITTSBURG, PA.—Mr. C. L. Magee, president of the Consolidated Traction Company, has called a meeting of the stockholders to be held on June 20, when the subject of a general consolidation of all the street railways of the city will be again considered, and it is expected that the opposition, which was manifested against the scheme last month, has now been removed, so that the plans as originally laid out will eventually be accomplished.

WABASH, IND.—Franchises for four electric interurban lines have been granted by the commissioners through this county, but not more than one is likely to be built this season. The first line to be built and that has the most substantial backing is the Wabash River Traction Company's line from Wabash to Peru. Its fate will be settled May 22, when this township will decide at an election whether it will vote a subsidy of $20,000.

OTTAWA, ONT.—Incorporation has been granted by the Ontario Government to the Whitby Street Railway & Park Company, of Whitby, Ont. The company consists of Lawrence Heyden, of Toronto, and J. B. Dow, James, Rutledge, L. T. Barclay, T. A. McGillivray, A. M. Ross, W. J. R. Richardson, H. M. Ross, F. Hatch and T. Grierson, all of Whitby. In addition to building the railway, the company proposes to furnish electricity for light, heat and power purposes. The capital stock is $30,000.

THE AUTOMOBILE.

THE SELMA AUTOMOBILE COMPANY, of Selma, Cal., has been incorporated with a capital of $250,000. The incorporators are J. Brownstone, N. W. Steward, A. B. Wasgatt, E. L. Shortridge, E. E. Shepard, all of Selma.

THE OVERMAN AUTOMOBILE COMPANY has been incorporated in Jersey City. Capital, $250,000. Incorporators: A. H. Overman, of Springfield, Mass.; W. R. Warren, H. R. Bradbury, D. R. Rianhard, W. P. Williams, all of New York.

THE BOSTON GAS MOTOR & AUTOMOBILE COMPANY has been incorporated at Kittery, Me. Capital, $500,000. Incorporators: C. L. Clodman, of Leominster; W. H. Mitchell, of Melrose; P. Yarrington; W. S. Harper, of Boston; F. E. Rowell, of Kittery; F. E. Rowell, attorney, Kittery.

THE NEW ERA AUTOMOBILE COMPANY, of Portland, Maine, has been incorporated to manufacture automobiles. Capital, $300,000. Incorporators: W. P. Burrell, of Boston, Mass.; A. Pennington, J. R. McLean, both of Cleveland; A. J. Desmond, H. L. Cramm, both of Portland; W. H. Abbott, of Winchester; O. B. French, of Lakewood; F. Hale, attorney, Portland.

PHILADELPHIA AUTOMOBILE CLUB.—Forty-two owners of automobiles have formed the Philadelphia Automobile Club. The officers are: Henry G. Morris, president; Herbert Lloyd, first vice-president; Pedro G. Salom, second vice-president; J. Horace Harding, third vice-president; Frank C. Lewin, secretary and treasurer. The governors are: G. Jason Waters, chairman; Robert C. Glendinning, W. W. Gibbs, John L. Wilson, H. G. Morris, Herbert Lloyd and Frank C. Lewin.

NEW INDUSTRIAL COMPANIES.

THE FOLLOWING named companies have been recently incorporated:

THE FEDERAL ELECTRIC COMPANY, of New York City. Capital, $1,000. Directors: Benjamin Blum and Nathan Blum, New York City.

THE CARLETON ELECTRIC COMPANY, of New York City. Capital, $100,000. Directors: Henry Guy Carleton, Charles E. Phelps, New York City; John C. Osgood, Denver, Colo.

THE B. & H. ELECTRIC CONSTRUCTION & SUPPLY COMPANY, Kittery, Me. Capital, $30,000. Incorporators: L. M. Cook, L. H. Murphy, J. Murphy, A. Brownell, all of Providence; F. E. Rowell, attorney, Kittery.

THE CONSUMERS' GAS & ELECTRIC COMPANY, Davenport, Ia. Capital stock, $300,000. Incorporators are: J. R. Nutting, Oscar Kehler, August Steffen, S. F. Smith, E. H. Ryan, M. A. Walsh, J. W. Walsh, C. H. Walsh and E. C. Walsh.

THE CATARACT CHEMICAL COMPANY, Niagara Falls. Capital, $100,000. Incorporators: H. E. Knight, W. E. Knight, D. E. Newland, M. E. Waldstein, all of New York City; C. B. Jacobs, of East Orange, N. J.; Knight Bros., attorneys, New York.

THE RYDER MANUFACTURING COMPANY, Binghamton, N. Y.; to manufacture electrical supplies. Capital, $50,000. Incorporators: C. A. Ryder, C. E. Lee, J. Anderson, T. D. Stewart, I. T. Deyo, all of Binghamton; Carver & Deyo, attorneys, Binghamton.

THE PITTSBURG GAS ENGINE COMPANY has been chartered at Harrisburg, to manufacture gas engines after the McCall patents. The incorporators are Thomas M. Rees, William Rees, David A. Rees, Harry A. McCall and Joseph H. Blackburn, of Pittsburg. Officers have not yet been elected. The engines will be made in the factory of Thomas Rees & Company, on Duquesne Way, Pittsburg, Pa.

OBITUARY.

AMOS F. BREED, former president of the Lynn & Boston Street Railway Company, died in Lynn at the age of 69 years.

BENJAMIN F. ELY, a well-known, old-time telegrapher, died at his home in Brooklyn on May 19 of inflammatory rheumatism. He was born in Springfield, Mass., in 1828. He was in the telegraph service 52 years. He was a man of rare culture.

PERSONAL.

MR. E. WARD WILKINS, of the well-known firm of Partrick, Carter & Wilkins, with headquarters at Philadelphia, Pa., is visiting Chicago this week.

MR. WILLIAM T. BENALLACK, of Detroit, State Electrical Inspector for the insurance companies in Michigan, left for the Paris Exposition on May 22.

MR. A. HALL BERRY, manager of the electrical department of the H. W. Johns Manufacturing Company, sails for Europe June 9, for a two-months' trip.

MR. J. A. WILLIAMS, of the Dawson Electric Light & Power Company, Dawson, Yukon, has returned home after spending ten days in New York, purchasing electrical machinery and supplies.

MR. A. L. KASSON, president Northwest Fixture Compny, Seattle, Wash., was a visitor to New York last week and reports business exceptionally good in the various lines handled by his company.

MR. LOUIS G. LE BOURVEAU, of the Telephone Manufacturing Company, Sumter, S. C., was married on May 29 in Jacksonville, Fla., to Miss Bertha Mabel Chappell, daughter of Mr. and Mrs. G. E. Chase.

MR. W. W. SKILES, president of the Shelby Electric Company, has received the nomination for representative of the 14th District of Ohio. This is equivalent to an election in this district. Electrical people are always getting to the front.

MR. HENRY H. HUMPHREY, of St. Louis, Mo., has been retained as consulting engineer by the City Lighting Company, of St. Louis, for the Knox estate, corner of Broadway and Franklin Avenue, and the Rice-Stix Dry Goods Company, all of St. Louis. Mr. Humphrey has recently moved his office to the Century Building.

MR. LUCIUS T. GIBBS, formerly of the Gibbs Electric Company, Milwaukee, which was absorbed by the Westinghouse Electric & Manufacturing Company, is devoting his attention to the manufacture of automobiles. His patents on automobile construction are being used by Fred R. Wood & Son, New York, where Mr. Gibbs holds the position of engineer.

Trade Notes.

THE PENNSYLVANIA RAILROAD COMPANY has just ordered a complete equipment of Cross oil filters from the manufacturers, the Burt Manufacturing Company, at Akron, Ohio, for its Fort Wayne shops.

GARTON LIGHTNING ARRESTERS.—The Western Electric Company is sending out to the trade a neat eight-page bulletin describing the Garton lightning arresters. It is well illustrated and contains a complete price list.

THE COMMERCIAL ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., has issued a handsome catalogue, in which it describes the full line of Lundell fan motors for 1900. Every style of these machines is very handsomely illustrated, each being briefly described.

MESSRS. HUEBEL & MANGER, manufacturers of brass and electrical goods, 286 Graham Street, Brooklyn, N. Y., have just issued a catalogue of electric bells, push-buttons, etc. The catalogue shows that this firm manufactures a very extensive line of these goods.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has been appointed agent for the celebrated line of annunciators manufactured by Partrick, Carter & Wilkins, of Philadelphia. The Chicago depot will prove a convenience for the Southern and Western trade, insuring quick shipments.

DESK AND CEILING FANS.—The Emerson Electric Manufacturing Company is sending out a card illustrating its several models of desk and ceiling fans, with a notification added that prompt shipments are made both from the factory in St. Louis and from their New York branch at 136 Liberty Street.

SAFETY ELECTRIC WATER-TIGHT DOORS.—Bulletin No. 500 of the Sprague Electric Company is devoted to a safety system of water-tight doors operated by electric power. This is the type of compartment door adopted by the government for the U. S. S. Atlanta and installed on the Ss. St. Paul.

FOOT PRESSES.—C. A. Crosby & Company, 176 South Clinton Street, Chicago, Ill., describe in a recent catalogue a line of foot and hand presses ranging from a small die press to a size weighing over one ton. The presses operate upon the screw, lever or pendulum principle, according to the duty to be performed.

EFFECT OF THE STRIKES.—Like many of the other electrical firms in New York, the C & C Electric Company is feeling the effects of the numerous strikes throughout the country. Its business for the month of May, however, has been very good and a slight lull may enable it to catch up with its back orders.

THE BUFFALO FORGE COMPANY was compelled to shut down its foundry at Buffalo, N. Y., last week on account of the molders' and coremakers' strike. This company is installing quite a number of its down draft forges in the shops of the Brooklyn Rapid Transit Company, but the work is fortunately too far along to be affected by the tie-up.

BATES FANS.—Messrs. D. L. Bates & Company, Dayton, Ohio, have issued a catalogue of their electric ceiling fan motors. These fans are wound for direct and alternating currents. The various styles are well illustrated in the pamphlet, which also gives a brief description of each machine. The firm is also making a line of water-motor fans.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, describes in a recent catalogue the principal features of and fully illustrates its electric generators and motors. The illustrations are of artistic execution and show in a very clear manner the various component parts of these machines, also machines complete, besides various applications of the same.

THE STUCKY & HECK ELECTRICAL MANUFACTURING COMPANY, LIMITED, has been purchased by Louis Heck. There will be no change in the management, which has been in the hands of Mr. Heck since the organization of the company, and exclusively since Nov. 4, 1898. The new company is being rushed to fill orders, the works being run overtime to turn out work promptly.

THE FALCON ELECTRIC MANUFACTURING COMPANY, New York, is about to place on the market a new removable fuse-holder and removable fuse-holder panel, which will be an improvement over anything in this line yet produced. This ingenious and economical article will be ready in about two weeks. During May the sales of the Falcon Company's various other lines exceeded expectations.

MAYER DYNAMOS AND MOTORS.—Bulletin No. 7 of the Maxwell M. Mayer Electric Company, 2369 Second Avenue, New York, is devoted to direct-current motors and dynamos, ranging from 1 to 5 horse-power. One of the illustrations shows a double generating set, the balance of which is so perfect that it is operated on the floor of a class room in a manner so noiseless as not to interfere with the class-room work.

LARGE INDUCTION COILS.—Queen & Company have received an order from a foreign government for two Ruhmkorff induction coils which will be the largest ever made. The celebrated Spottiswoode coil, built under the auspices of the Royal Society, gave a spark of 42 inches. The Queen coils are to give a spark of 45 inches, expending an energy of 3 to 4 horse-power, and having a secondary potential of half a million volts.

A REMARKABLE PHOTOGRAPH.—Probably one of the most remarkable exterior photographs ever made is a view taken by George P. Hall & Son, 157 Fulton Street, of lower New York. The photograph was taken from the North River, and the view extends from about Cortlandt Street to the upper boundary of the Battery. Messrs. Hall have issued a calendar containing an excellent reproduction of the photograph, the engraving being 15 ins. long.

STANDARD WHITE SWITCHES.—H. P. White Company, Limited, Philadelphia, Pa., has issued a neat little pamphlet giving illustrations of and a few points on standard White switches. These switches are made in sizes ranging from 35 to 400 amperes, single, double, triple and double blades. The contacts are flexible and take up all wear automatically. The company also manufactures tablet boards, distribution boards and panel boards, and switchboards of every description.

MR. C. D. JENNEY, president of the Jenney Electric Manufacturing Company, was a visitor to New York City last week on some important business matters. He reports that the business of his company has been unusually good during the past two months, and that he has found a great demand in foreign countries for American manufactures, which applies directly to his own company. The excellence of the dynamo-electric machinery built by the Jenney Electric Manufacturing Company has commended it to users in all parts of the world.

THE B. F. STURTEVANT COMPANY has recently installed two of its steel plate electric fans in the coffee-roasting mill of Arbuckle Bros., Brooklyn, N. Y. The fans are each direct connected to a 7-hp multipolar motor and are used to exhaust the hot air from over the roasting furnaces. The air is conveyed in large pipes from the furnaces and discharged by the fans through the roof. As the temperature of the air is very high, a fibre disk is placed between the coupling flanges of fan and motor, so that the motor may not become overheated.

TRAIN LIGHTING.—Since its recent formation the Consolidated Railway Electric Lighting & Equipment Company has made several contracts with some of the principal railways of the country. A car fitted with a complete installation of the company's apparatus will be in Saratoga during the conventions of the Master Car Builders' and American Railway Master Mechanics' associations, June 18 to 23. Several officers of the company expect to attend the conventions and will be ready to demonstrate to the members of the two associations the many advantages of the Consolidated's system of lighting railway trains.

CHARLES H. BESLY & COMPANY, 10 North Canal Street, Chicago, Ill., is introducing a compound called "Mannocitin," which is claimed to be the only absolute rust preventive for machinery, engines, tools, guns, cycles and all metals. "Mannocitin" is composed of greases and volatile oils. It remains absolutely neutral, and contains no acid. On application, the oils evaporate, leaving an air-tight film or skin, which adheres tightly to the metal, and absolutely and permanently prevents rust and corrosion. It withstands salt air, salt water, rain, snow, dampness, perspiration, steam, gases and fumes of acids and ammonia.

SAFETY INSULATED WIRE AT THE PARIS EXPOSITION.—The Safety Insulated Wire & Cable Company, New York City, is sending out an invitation to the trade to visit its space in the palace of electricity at the Paris Exposition. It is also sending out advance copies of its exposition souvenir which consists of a folder giving illustrations of samples of its wires and cables for various uses. The samples are classified under the heads of Army, Navy, Power and Intelligence, and a brief reference of these four classes is printed in English and French. The front cover of the folder is handsomely designed and represents applications of electric cables and wires in these four classes of work.

PORTABLE CRANES.—The Franklin Portable Crane & Hoist Company, Franklin, Pa., is putting on the market a portable crane for hoisting and transporting machinery. The machines are so built that any weight up to three tons is portable with the use of them. Some of the largest electrical manufacturers have found this crane a great convenience in handling armatures and parts of electrical machinery, because of the ease of operation of the crane and the facility with which it may be transported from place to place in a building, or taken from one building to another. The cranes are particularly adapted to electrical work, and are especially useful in repair shops and manufacturing plants where a traveling crane is not required.

MR. WILLIAM ROCHE, 42 Vesey Street, New York, inventor of the New Standard dry battery, has decided to make up an eight-cell battery for automobile gasolene engine ignition. It is set up with four cells in series and four cells in reserve, and by means of a switch the reserve cells can be thrown into circuit one by one, as necessary. The case is made so that when the cells are exhausted they can be taken out and new ones replaced. It is neat and compact and measures 12x6x9 ins., and weighs only 21 lbs. This battery is meeting with most encouraging success. Mr. Roche is also putting out a nine-cell battery for carriage lights, square in form, 9x9x12, and weighing 24 lbs. This outfit is set up with a three-point switch and the cells in three series of three each, thus giving three complete batteries in the one box. For carriage lights Mr. Roche says this outfit will give a good light on the two lamps for 500 hours, or 1000 hours on one lamp.

PARIS EXHIBIT.—Messrs. Eugene Munsell & Company and the Mica Insulator Company, of New York and Chicago, will have a joint exhibit at the Paris Exhibition. They were fortunate in securing a prominent position in the main floor of the Electrical Building, and their display will be in every way worthy of these large interests. Messrs. Munsell & Company have sent samples of every grade of mica used by the electrical trade, including many unique and rare specimens, which they have gathered during the 50 years the house has been engaged in the mica business. The Mica Insulator Company will show a full line of the Micanite insulators and insulating materials of which it is the originator and patentee, and also of the "Empire" insulating cloth and paper which are manufactured by the company's special processes. Descriptive pamphlets printed in all the principal languages of Europe will be given to visitors who are interested in the exhibit.

SEAMLESS METAL TUBING.—The Ellwood Ivins-Mills, Oak Lane Station, Philadelphia, and 487 Broadway, New York, are devoting considerable attention to making tubing for electrical purposes. They produce seamless tubing in most all metals, such as steel, aluminum, copper, brass, platinum, etc., in sizes from about 4 ins. in diameter, down to a tube with a diameter as small as a human hair, and with almost absolute accuracy. The plant covers two acres of ground and is used exclusively for the production of tubing. Many manufacturers of electrical wares who formerly drilled out rods for tubing are getting the exact sizes both inside and outside made in long lengths and simply cutting the tube off in sections, at a great saving in cost. They also make aluminum tubing about one-thirty-second of an inch in diameter for the "pointers" of volt and ammeters. These little tubes are made true and exact to size, both inside and outside measure, to the one-half of one-thousandth of an inch.

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY has recently moved its general office to its factory at 58 to 64 North Jefferson Street, Chicago. Owing to the largely increased business which the company has enjoyed during the past year or two, it has found it necessary to increase its manufacturing facilities, and has equipped a department for the manufacture of its well-known and popular line of tested fuse wire and fuse links, in connection with the Springfield Drop Forging Company, of Springfield, Mass. All shipments for the Eastern states will hereafter be made from the Springfield factory. It may be of interest to the trade to know that Mr. A. D. Dana, president of this company, is now treasurer and general manager of the Springfield Drop Forging Company, while Mr. W. R. Goodman, who has been well known in connection with the fuse-wire trade for the past 12 years, will continue to look after the interests of the business from the main office at Chicago.

THE NORTHWEST FIXTURE COMPANY, Seattle, Wash., has, through its New York agent, C. J. Purdy, 26 Cortlandt Street, just sold to the Dawson Electric Light & Power Company, Dawson, Yukon, its entire power transmission equipment, amounting to nearly $50,000. This is one of several large shipments recently made to the Far West. This wideawake Western concern has opened its Eastern office in order to be in closer touch with the large Eastern manufacturers, and is thus enabled through direct and personal dealings with the makers of all kinds of apparatus to render its own customers much better service in the way of shipments, deliveries, prices, etc. Besides its own various lines of fixtures, mantles, grates and other specialties, it carries a large stock of engines, boilers, dynamos, motors and electrical supplies, either new or second-hand. The enormous field in the great Northwest is a most fertile one for this enterprising concern and its constantly increasing business is evidence of the reputation it has established.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MAY 22, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

649,917. ELECTRIC SHAMPOO APPARATUS; H. C. Doersch and D. W. Cranston, Nyack, N. Y. App. filed Oct. 11, 1899. This is a barber's chair provided with fixed and movable electrodes for treating the scalp with electricity.

649,922. APPARATUS FOR ELECTRICALLY LIGHTING LAMPS; H. C. Farquharson, New York, N. Y. App. filed Sept. 5, 1899. The invention relates to the means for protecting the conductors leading to the sparking points. They are encased in porcelain sleeves which pass through metal tubes.

649,933. ELECTRIC RELEASING DEVICE FOR SHUTTERS; J. Hueston, New York. App. filed Aug. 19, 1899. This is a circuit extending to each of the windows of a building and there including electromagnetic latch mechanism for releasing all of the shutters simultaneously.

649,937. RHEOSTAT; C. Flohr and R. Dietze, Berlin, Germany. App. filed July 3, 1899. The movable contacts are relatively arranged to prevent sparking.

649,942. SYNCHRONIZER FOR ELECTRIC MACHINES; C. J. A. Michalke, Charlottenburg, Germany. App. filed Dec. 31, 1897. (See Current News and Notes.)

649,950. BATTERY PLATE; J. K. Pumpelly, Chicago, Ill. App. filed July 19, 1898. The plate consists of a core of perforated rolled sheet lead, and supports for the active material composed of lead cast on each side of the sheet, the supports being so arranged as to expose the core at intervals.

649,959. SIGNAL FOR TRUNK LINES OF TELEPHONE SYSTEMS; Chas. E. Scribner, Chicago, Ill. App. filed June 17, 1898. This invention consists in a system of visible signals, with means for operating them to enable the attendant at one terminal station of the trunk line to make, supervise and

remove connections between the trunk line and subscribers' lines with efficiency and slight liability to error.

649,972. ELECTRIC MOTOR CONTROLLING DEVICE; P. S. Watson, Milwaukee, Wis. App. filed Oct. 4, 1899. This is a convenient controller for dental engines, consisting of a casing carrying fixed brush contacts and a rotatable drum, the latter being held in a central position by a spring and moved in either direction therefrom by a treadle.

649,976. ELECTRIC INCANDESCENT LAMPS; J. Apherton, London, England. App. filed July 24, 1899. The base of the lamp is held upon the neck by means of a binding wire, which passes through slots in the side of the base and enters grooves in the sides of the neck.

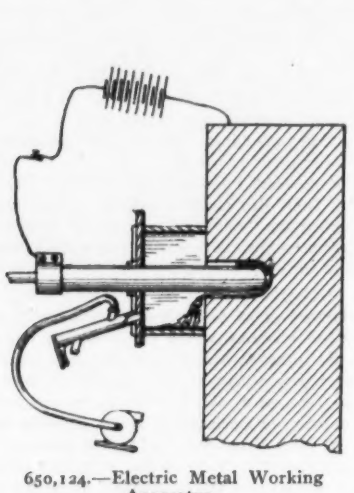
649,989. SYSTEM OF ELECTRICAL DISTRIBUTION FOR ELECTRIC RAILWAY; F. R. Koss, Charlottenburg, Germany. App. filed March 8, 1900. The system consists of a main supply conductor, a plurality of auxiliary supply conductors connected therewith and sets of contacts, the number of sets corresponding to the number of auxiliary conductors, the contacts of each set being electrically connected with one of the auxiliary supply conductors and each contact of any set being arranged alternately with the contacts of another set.

649,990. UNDERGROUND ELECTRIC RAILWAY SYSTEM; J. B. Larkin, Pittsburg, Pa. App. filed Sept. 9, 1899. The slot is closed by plugging strips supported inside of the conduit on springs and arranged in an angular position, so that a pushing device carried by the car may force it downward and to one side to admit the plow.

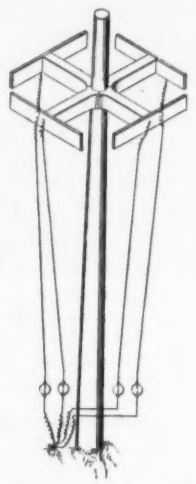
649,994. AUTOMATIC CIRCUIT CLOSER FOR TELEGRAPH KEYS; L. F. Ritchie, Elwyn, Pa. App. filed Oct. 12, 1897. The finger of the operator when applied to the button of the key holds the circuit closer open, but when the operator removes his hand from the key a spring acts upon the device to close the circuit.

649,998. ELEMENT FOR STORAGE BATTERIES; E. A. Sperry, Cleveland, Ohio. App. filed Sept. 30, 1899. This is a thin sheet lead plate having certain strengthening ribs located to give the greatest support.

650,010. ELECTRIC SWITCH; J. B. Heller, Philadelphia, Pa. App. filed Sept. 23, 1899. This invention relates to inter-related switches; the switches



650,124.—Electric Metal Working Apparatus.



650,255.—Space Telegraphy.

are provided with independent levers and means whereby operative connection of each of the levers with its switch is dependent upon the position of the switches themselves.

650,014. ELECTRIC MOTO-CYCLE; I. Kitsee, Philadelphia, Pa. App. filed July 3, 1899. This invention is a battery adapted for motor vehicles. The battery comprises positive and negative electrodes, solid chemical depolarizing material, in contact with the negative electrode and means for causing the depolarizing material to move over the surface of the negative electrodes.

650,015. ELECTRIC WELDING; E. Lagrange and P. Hoho, Brussels, Belgium. App. filed Aug. 15, 1892. (See Current News and Notes.)

650,030. APPARATUS FOR OPERATING CONTACTS FOR ELECTRIC TRACTION; A. Ballance and S. A. Jefferson, Hull, England. App. filed Nov. 10, 1899. According to this invention, the circuit to the working conductor sections are closed automatically by trucks carried by the vehicle and striking certain levers in the roadbed which move the switches in the contact boxes.

650,051. ELECTROPLATING APPARATUS; L. Potthoff, New York, N. Y. App. filed Aug. 2, 1899. The articles to be plated are placed in a carrier which is caused to traverse the solution in the tank for the purpose of depositing an even plating.

650,057. CONTROLLER FOR ELECTRIC CIRCUITS; A. L. Waters, San Francisco, Cal. App. filed Aug. 2, 1899. This is a rheostat consisting of a cylinder of non-conducting material, having a resistance wire wound around it from end to end; a screw is placed inside and carries a nut which may be moved back and forth to cause a finger attached to the nut and projecting through a slot in the side of the cylinder, to make contact with the external wire.

650,062. THERMO-ELECTRIC PILE; L. Gottscho, Charlottenburg, Germany. App. filed Dec. 19, 1899. The warm joints are enclosed in a heat-retaining casing, and are connected with the cold joints by conductors of small cross section to avoid heat loss.

650,094. TRACK AND CONDUIT CONSTRUCTION FOR UNDERGROUND ELECTRIC STREET RAILWAY; J. H. Robertson, New York, N. Y. App. filed Aug. 18, 1899. The yokes carry wooden string pieces upon which the rails rest.

650,096. RECORDER FOR RAPID AUTOMATIC TELEGRAPHY; C. F. Rodde, Berlin, Germany. App. filed Feb. 3, 1900. Means for producing cathode rays in combination with an electromagnet adapted to deflect the rays and means for registering such deflections.

650,109. APPARATUS EMPLOYED IN WIRELESS TELEGRAPHY; G. Marconi, London, England. App. filed Oct. 12, 1899. (See page 827.)

650,110. APPARATUS EMPLOYED IN WIRELESS TELEGRAPHY; G. Marconi, London, England. App. filed Dec. 28, 1899. (See page 827.)

650,113. INSULATING COUPLING; L. McCarthy, Boston, Mass. App. filed March 9, 1899. A tube coupling having a petticoat cover of insulating material to shed moisture.

650,115. INSULATING COUPLING FOR ELECTRIC WIRE CONDUIT; G. W. Prouty, Littleton, Mass. App. filed April 27, 1899. Details of construction.

650,119. ELECTRICAL SWITCH; E. J. Wade, London, England. App. filed March 8, 1900. The disposition of the contacts on the surface of a barrel switch is the subject of this invention.

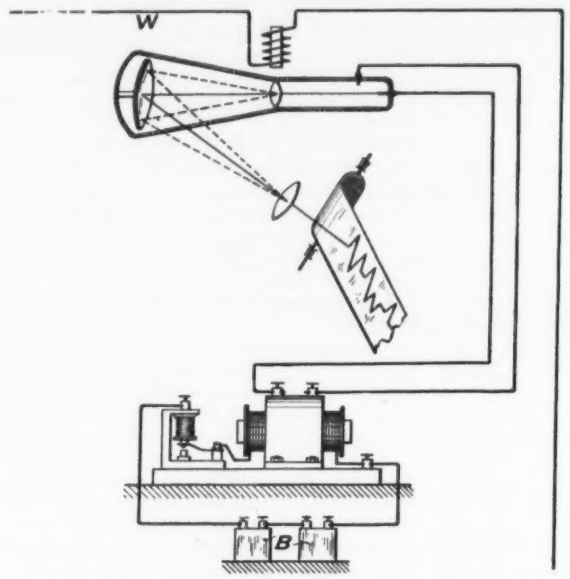
650,123. CONTACT DEVICE FOR ELECTRIC RAILWAY; W. M. Brown, Johnstown, Pa. App. filed Sept. 20, 1899. In order to make a moisture-proof connection between a lead-covered cable and a switch box, the end of the lead sheath is flared and fitted to a seat inside of the box.

650,124. ELECTRIC METAL WORKING APPARATUS; C. Coleman, Chicago, Ill. App. filed July 29, 1897. For working upon the surface of large bodies of metal, the operating electrode is surrounded by a muffling box which muffles the noise and catches the molten metal.

650,141. STATIC INDUCTION GENERATOR; R. V. Wagner, Chicago, Ill. App. filed Nov. 29, 1899. The disk is composed of mica and shellac.

650,172. TELEGRAPHIC SOUNDER; A. A. Dittmar, Jersey City, N. J. App. filed Feb. 26, 1900. That part of the base plate supporting the anvil is made very thin, so as to vibrate and amplify the sounds, while the other portion of the plate is made heavier for strength.

650,178. MANUFACTURE OF FILAMENTS FOR INCANDESCENT ELECTRIC LIGHTS; S. B. Husselman, Worcester, Mass. App. filed Feb. 16, 1900. (See Current News and Notes.)



650,096.—Recorder for Rapid Automatic Telegraphy.

650,196. SWITCH FOR ELECTRIC MOTORS; G. A. Schoeller, Mulheim-on-the-Ruhr, Germany. App. filed Feb. 1, 1900. Details of construction.

650,219. STORAGE CELL; F. W. Barhoff, Hartford, Conn. App. filed July 29, 1899. The electrodes are in the form of rods around which a lead ribbon is wound, between the turns of which the active material is deposited.

650,234. PROCESS OF MAKING CARBORUNDUM ARTICLES; F. A. J. Fitzgerald, Niagara Falls, N. Y. App. filed Aug. 7, 1899. (See Current News and Notes.)

650,235. CARBORUNDUM ARTICLE; F. A. J. Fitzgerald, Niagara Falls, N. Y. App. filed Aug. 7, 1899. (See Current News and Notes.)

650,246. ARMATURE FOR DYNAMIC ELECTRIC MACHINES; G. Heidel, St. Louis, Mo. App. filed Sept. 18, 1899. A burned-out coil may be cut out without affecting the other sections.

650,247. ELECTRODE FOR SECONDARY BATTERIES; F. Heimel, Vienna, Austria. App. filed June 7, 1898. Structural details.

650,255. SPACE TELEGRAPHY; I. Kitsee, Philadelphia, Pa. App. filed May 20, 1899. For determining from which direction a message comes, it is proposed to use a series of aerial conductors placed at the different compass points, and each having a separate circuit and receiving device therein.

650,258. ACCUMULATOR PLATE; W. Majert, Grunau, Germany. App. filed Dec. 19, 1899. In a plate having parallel ribs projecting from its face the ribs are mechanically supported by a cross rib at one end.

650,274. VOLTAIC BATTERY OPERATED WITH FUSED MATERIALS; W. S. Rawson, London, England. App. filed June 19, 1899. (See Current News and Notes.)

650,275. ELECTRIC LIGHT DIMMER; R. E. Reeve, New York, N. Y. App. filed Aug. 25, 1899. The dimming rheostat is placed in the canopy at the base of the fixture supporting the lamp.

650,305. COMPOSITION FOR EXCITING FLUID FOR ELECTRICAL BATTERIES; F. G. Curtis, Everett, Mass. App. filed Aug. 21, 1899. A solution for the zinc electrode, consisting of sufficient sulphuric acid to make the specific gravity of 30 gallons of water 1.2, sulphate of ammonium about 1¾ lbs., sulphate of sodium, about two-thirds of 1 lbs. and bisulphate of mercury one-half lb.

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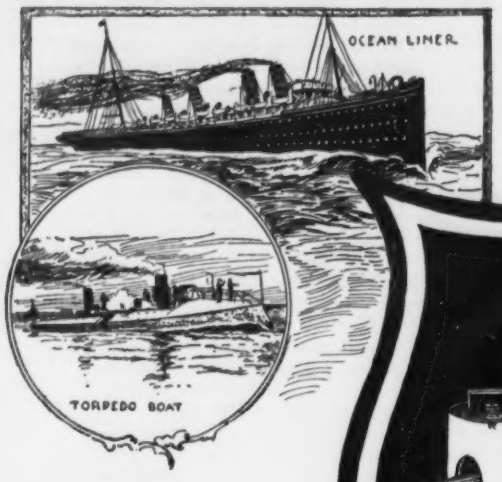

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Highest Standard in the World for

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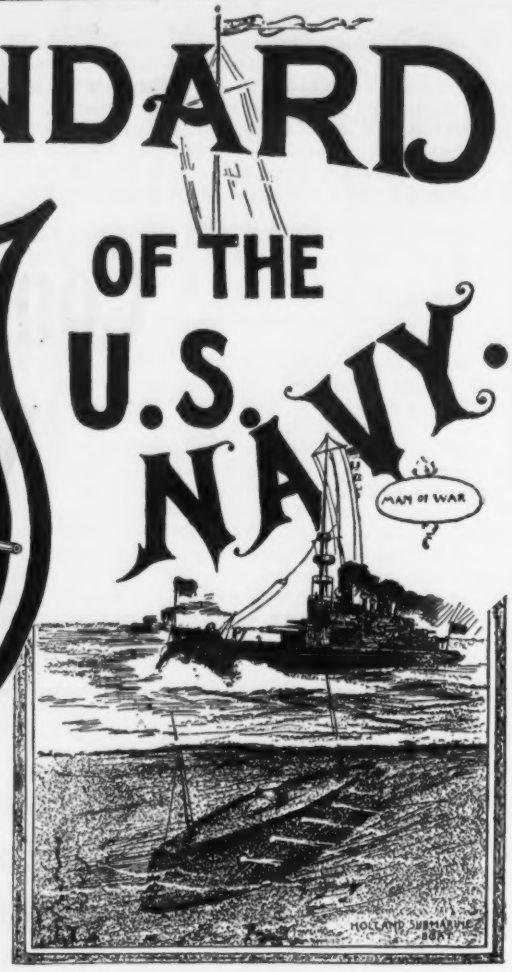

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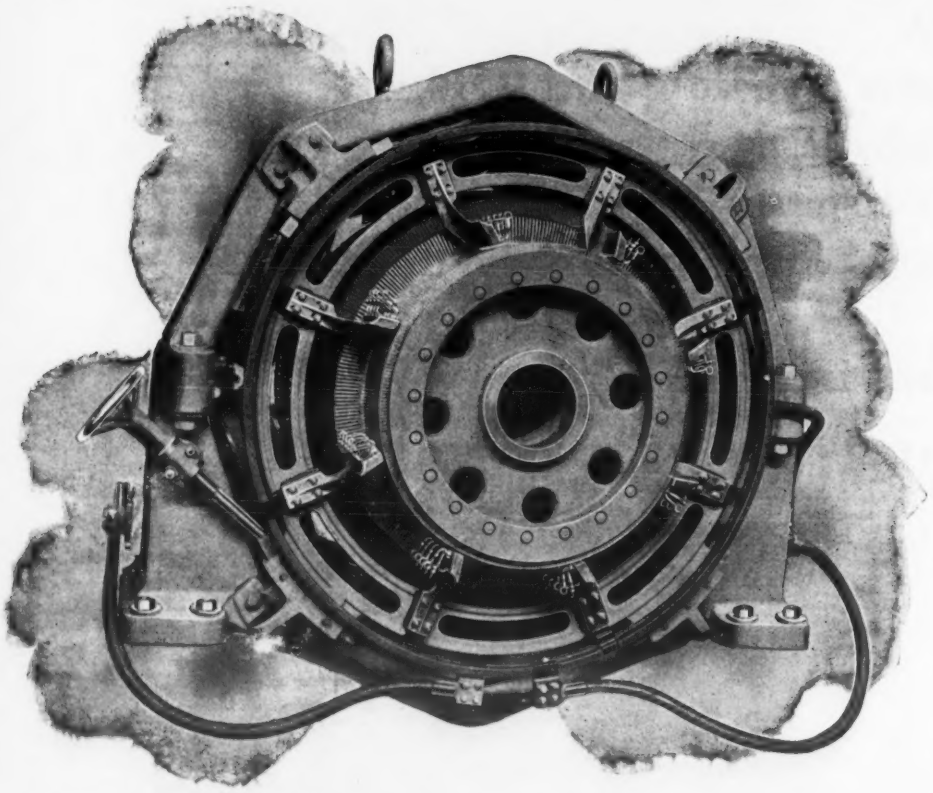

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DIRECT-CURRENT LIGHTING AND POWER GENERATORS.

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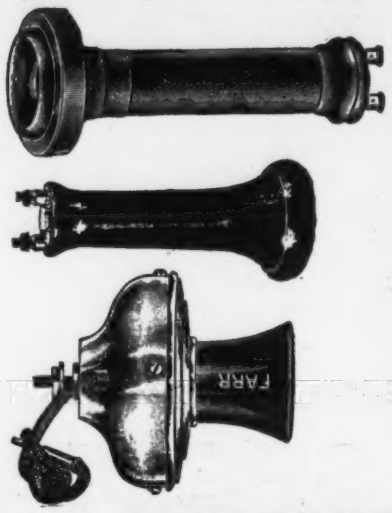
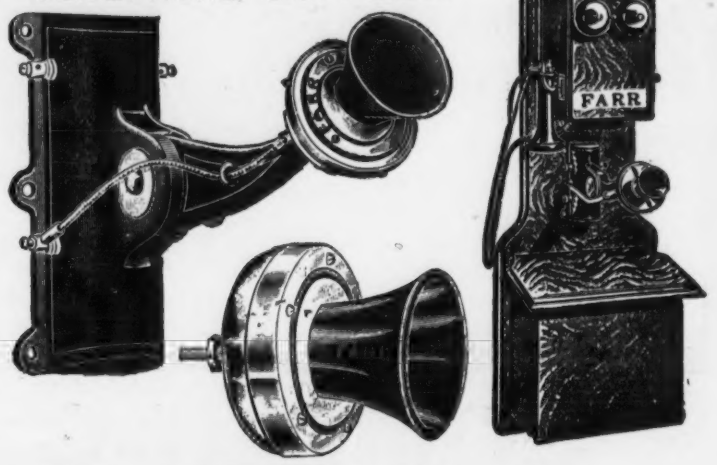


TELEPHONE SUPPLIES.



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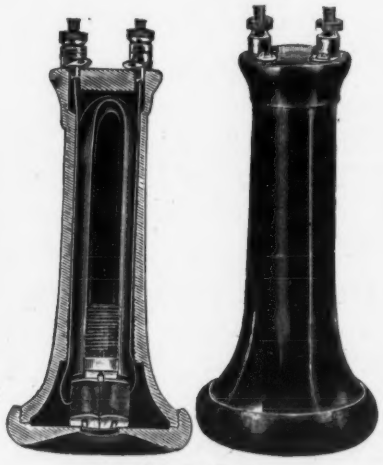
Barr's Patent Long Arm Concealed Cord Transmitter.

Complete, with Induction coil, $2.25. Others charge $3.50 for an inferior article. This Transmitter is absolutely the best on the market.



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Our apparatus is better in quality and at least $2.00 cheaper than any other manufacturer.

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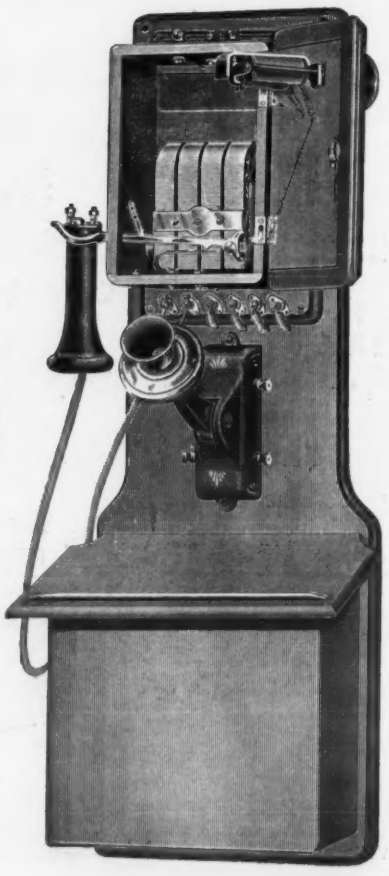

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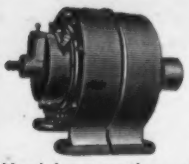
SMALL A. C. POWER MOTORS.



These motors have been adopted by the United States Postal Service. They are self-starting under full load, with normal current consumption. Easy to install and simple in operation. Used for operating automatic pianos, advertising devices, static machines, dental lathes, etc.

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1-3 AND 2-3 H. P. BIPOLAR MOTORS.

These machines are graceful in design, substantial and well finished. Pole pieces are of soft magnet steel, cast in one piece. Insulation is perfect. Brush holders are of the most approved type. The armature shaft is of the best crucible steel, polished to bearings.

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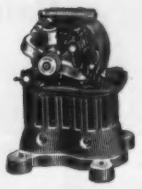
220 AND 500 VOLT MOTORS.



Where small motors are called for on 500-volt circuits, high insulation is of the utmost importance. In this motor the insulation is the best; double-covered silk wire is used, and nothing is spared to make this a durable and safe running machine. Phosphor Bronze self-aligning bearings are used.

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The H. C. 4-magnet style is suitable for small exchanges. A powerful Generator, with ample output for 500 subscribers. We also make a 5-magnet style, with output for 2000 subscribers and upwards. A machine absolutely perfect.

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Substantially builtfor linemen's use, and provided with strap for carrying. Ringing resistance is plainly marked on each instrument. We can also furnish our regular Standard Magneto (ringing through 15,000 ohms) to parties desiring a magneto with bells on outside of case. The neatest and most desirable Testing Generator on the market.

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MULTIPOLAR Motors and Dynamos

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All sizes. 1 to 60 H. P.

Fully described in our Bulletin No. 19.

PLATING DYNAMOS.

We manufacture a full line of Plating Dynamos. The accompanying cut represents our smallest size Type M O O, which has an output of 18 amperes at 6 volts. It will plate 15 sq. ft. of nickel per hour. Our larger sizes—multipolar machines—are built with the same thoroughness and attention to details that characterize the construction of our motors and dynamos.

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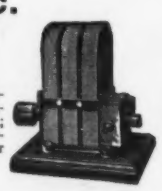
SMALL POWER MOTORS.

This cut represents our small 110 volt Direct Current Motor with clamp attachment. We make these in three sizes, 1-10, 1-8, and 1-6 h. p. Can also furnish them on flat base or with speed regulating rheostat in base. We manufacture 1-6 h. p. 220 and 500 volt Motors, 1-8 and 1-6 h. p. Alternating Motors, Dental Motors, etc. Also a full line of D. C. Fan Motors. *Send for Bulletin No. 108 of Small Motors and also for Fan Motor Catalog.*

THE H.-C. GAS ENGINE IGNITER.



The most satisfactory machine yet devised for igniting Gas and Gasoline Engines. It has permanent magnet fields; an enclosed armature; self-feeding carbon brushes, and it may be run in either direction.

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This Fan is constructed electrically and mechanically perfect. It has double swing, can be set at any angle and fitted up or down. It is dust proof, elegant in design, effective in operation and perfectly noiseless.

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In the professional work of the dentist, the small electric motor is steadily finding an extended field of usefulness. With suitable regulating devices, it is proving to be the best source of power for operating dental engines, lathes, etc.

This cut illustrates the H. C. Dental Lathe Motor, with speed regulator in base, and with extended spindles to which may be attached the different chucks for carrying tools for polishing and grinding. Price of Motor complete with cord, attaching plug and five chucks, $40.00.

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Should be in every Factory, Warehouse, School, Hotel or Public Building where quick intercommunication between floors, rooms or separate buildings is desired. The switch returns automatically to its home point upon hanging up the receiver. Thoroughly reliable. Endorsed by the leading electrical engineers.

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The New H.-C. Watch Case Receiver

is a superior article, not having the defects common to other makes. Shell of best quality hard rubber. Permanent magnets are strong and accurately adjusted in relation to diaphragm, and formed so as to obtain greatest effective length with pole pieces close together, an arrangement hitherto disregarded. A nickel plated stamping over permanent magnets gives finish and weight to the receiver.

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